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Sheet-Metal Products

Their Design Use and Construction

By Frank W. Curtis
Western Editor, American Machinist

SHEET-METAL products are finding a broader application in the manufacture of mechanical products as compared to the limited field they covered a few years ago. Such a growth is the outcome of combined results achieved through miscellaneous developments and research carried on by manufacturers of materials, and by concerns making sheet-metal products.

Sheet-metal is used for making a variety of products that heretofore were made of castings or forgings. Such a change does not indicate that castings or forgings are becoming undesirable, because their uses are, on the other hand, broadening by new applications, just as sheet-metal is continually being applied to new fields. Competition has brought about a continual change of design, largely for the purpose of cost reduction, and although labor is of primary consideration, the cost of materials or raw products is considered in the same category.

Sheet-metal products have not only played an important rôle in the automotive industry, but also in many other industries. The variety of uses includes such units as stoves, cash registers, railway journal-boxes, bath tubs, car seats and caskets.

Sheet-metal products have four outstanding advantages. These are: A lower material cost, less waste, economy in production, and a better appearance. One limiting factor of a pressed-metal product is the quantity to be manufactured. Generally speaking, the quantity must be large enough to warrant the cost of dies or other tool investment. If the output is small, the tool cost is likely to be prohibitive. The trend of design change is another factor controlling the use of sheet-metal parts. Products subjected to constant re-design do not lend themselves to production in dies.

Rules governing the possible use of dies for sheet-metal products, or when dies should be used, or even what production should be required to make dies practical, are difficult to give. Each piece requires individual analysis and is a problem in itself.

Comparison of a cast-iron and a sheet-metal pulley, both having approximately the same specifications are illustrated at *A* and *B* in Fig. 1. The sheet-metal pulley is made of three pieces, two of which are alike and made in the same dies. A product of this type can be made up to size and requires no machining. An assembling opera-

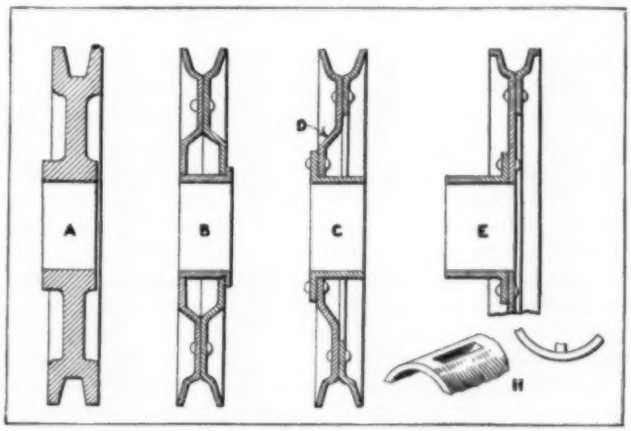


Fig. 1 — Comparative designs of a cast-iron pulley and several sheet-metal pulleys. Sheet-metal lends itself readily to a design of this character with the advantages of being stronger and lighter. Similar designs can be used by applying forged or cast hubs

The first part of the article. The conclusion will appear in an early issue.

tion is required, but the time consumed is far less than the time required to machine the cast-iron pulley. Another form of pressed-steel pulley is illustrated at *C*. A design of this kind is somewhat lighter, although the assembling requires an additional operation. If the thickness of the metal and the general proportions are satisfactory, the hub can be drawn from the section *D*, thus making the construction simpler. The example at *E* is made along similar lines, with the exception that the web is straight and the hub is offset to meet specified conditions. In this case a keyway is used to align the pulley at assembly, and the sheet metal hub is made with a formed key as illustrated at *H*. An integral key of this kind is economical to produce and usually serves the purpose satisfactorily.

Various methods of providing bushings for sheet-

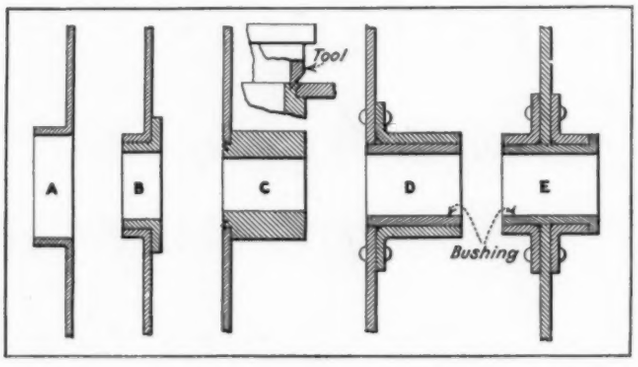


Fig. 2 — Several methods of applying bushings to sheet-metal parts. In some cases, the metal surrounding the hole can be drawn to provide a satisfactory bushing, while in other cases it is necessary to make the bushing a separate piece and attach it by some suitable means

metal parts are illustrated in Fig. 2. Of these, the simplest form is that illustrated at *A*, representing a bearing drawn from the sheet. The design lends itself to the application of a bronze bushing of the plain type, which is merely pressed in place and reamed at assembly. At *B* is shown the assembly of a flanged bushing in a sheet-metal hub. In many instances the thickness of the metal does not permit a hub of suitable size to be drawn from the metal around the hole, in which case bushing supports are required. One of these is illustrated at *C*, representing a machined bushing attached by means of staking. Directly above is shown how the staking tool forms the outer section of the hub over the countersunk hole. Other forms of mounting bushings to sheet-metal parts of limited proportions are illustrated at *D* and *E*. The constructions permit either short or long bushings to be applied as desired.

Riveting is used extensively for joining sheet-metal parts, and in Fig. 3 at *A* is shown a conventional form of assembling a hub to a flat part. Assemblies of this kind are usually made by means of dies, enabling a series of rivets to be headed in one stroke of the press. Rivets can be headed flat as shown at *B* if a smooth face is required. Spot welding, such as outlined at *C*, is also used in joining pressed-metal parts. Such an assembly is made by mounting the parts on a revolving fixture and welding the contacting faces at several convenient points. Another method of assembling is illustrated at *D*, which represents a means of attaching a washer to a drawn hub. The washer is pressed over the hub, then the projecting edge of the hub is rolled, or peened, over the washer. Spot welding can also be used.

Dowels for aligning sheet-metal assemblies are often made by punching slugs half way through the thickness of a sheet-metal part. The slugs are made to fit into punched or reamed holes in the adjoining part. In producing slugs such as the one illustrated at *E*, the height of the slug should not exceed half its diameter, nor half the thickness of the stock. In general practice, it is well to make the diameter of the slug equal to the thickness of the stock, and to have it project a distance equal to one-half its diameter. If an attempt is made to force the slug beyond this distance, it will pass through the work and a pierced hole will result. In some cases the slug can be used for assembling thin parts as illustrated at *H*. The construction shows an assembly made by two slugs that have their projecting ends riveted over the adjoining part.

Many forms of ears and eyelets are used for joining sheet-metal parts. In the construction shown at *J*, the tongue is made by punching a section from one of the pieces to be joined, the projection being at right angles to the joining face. After the corresponding part has been assembled, the tongue is bent over as shown. Another means of assembling two parts is illustrated at *K*. Drawn hubs of one part fit into openings of the adjoining part, then the projecting ends of the hubs are formed over the back face to produce a rigid assembly. Hubs of this type, not only hold the two pieces together but also form a means of accurate alignment. Such a construction has limitations, of course, the principal one being the thickness of the metal, which determines whether or not the hubs can be successfully drawn. A spot welded assebly, including two sheet-metal pieces and a small pinion, is shown at *L*. As illustrated, the stampings form a bearing for the pinion shaft.

Many other forms of assemblies are used, common among these being split rivets and drive screws. Machine screws can also be used by tapping one of the parts to be assembled, such as shown at *A* in Fig. 4. Tapped holes can also be used to assemble studs or plugs such as shown at *B*. In cases where the thickness of the stock does not permit a satisfactorily tapped hole, an eyelet such as shown at *C* can be used. The eyelet can be made of sheet metal or it can be a screw-machine product, the choice being determined by existing conditions. A similar

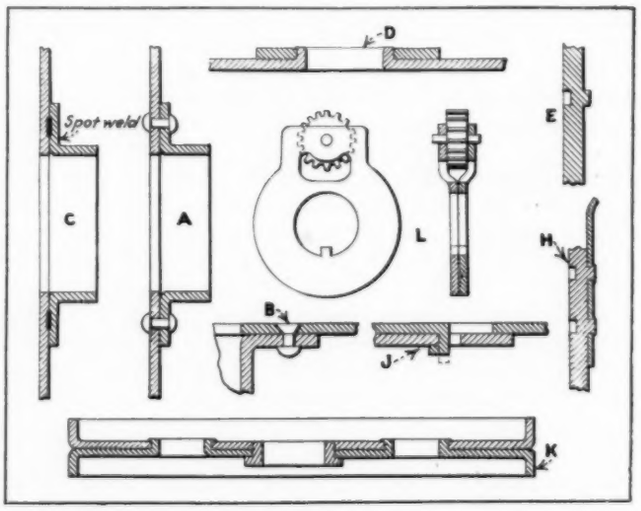


Fig. 3 — Various methods of joining sheet-metal parts, including the use of spot welding, the application of rivets, and the use of hubs and dowel pins. Constructions as shown have a wide application in the making of sheet-metal parts and unit assemblies

method of assembling may be used to fasten pins to sheet-metal parts, as illustrated at *D*. The projecting end of the pin is spun or riveted after assembly. Perhaps the most common form of assembling pins is that illustrated at *E*, in which the head of the pin is riveted over the back of the sheet-metal part to which it is attached. The hole can be countersunk, so that the rivet head does not project beyond the face of the work. Another form of ring staking is shown at *H*. In this case the hub to be joined is chamfered and the part assembled to it has its inner edge staked over the chamfer. When using this method of staking, care should be taken that the thickness of the hub is sufficient to withstand the pressure of the staking tool, so that the metal around the hole will not mushroom or cave in. Another use for ring staking is illustrated at *J*. The screw-machine piece to be assembled is splined by swaging four sections at the outer edge of the hub, as shown. The sections of metal swaged by the splining operation form a seat on which the stamping is located. The stampings are made with splined holes to correspond to the hub. The staking tool turns over the four splines as shown at *K*, thus making a tight joint, and one in which the assembled parts cannot turn. Swaging of sheet-metal parts saves time and material, and in many cases aids in producing a better part. Swaging is done cold, and a coining press is usually used for such operations.

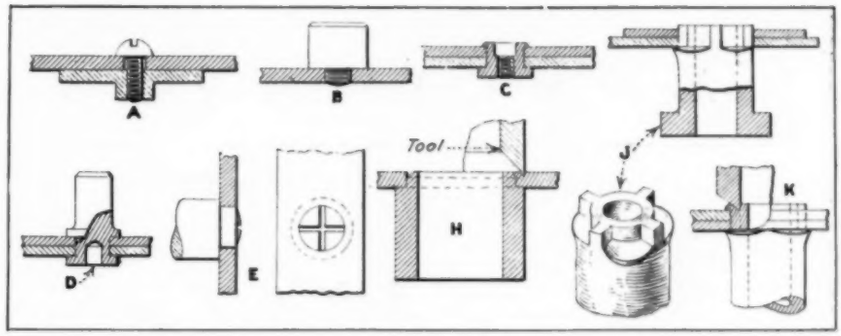


Fig. 4—Some practical methods of applying screws, pins, studs, and hubs to sheet-metal parts. Screw-machine parts can be joined by riveting, which includes the ring-staking process, or they can be joined by a threaded shank assembled to the sheet-metal frame or body

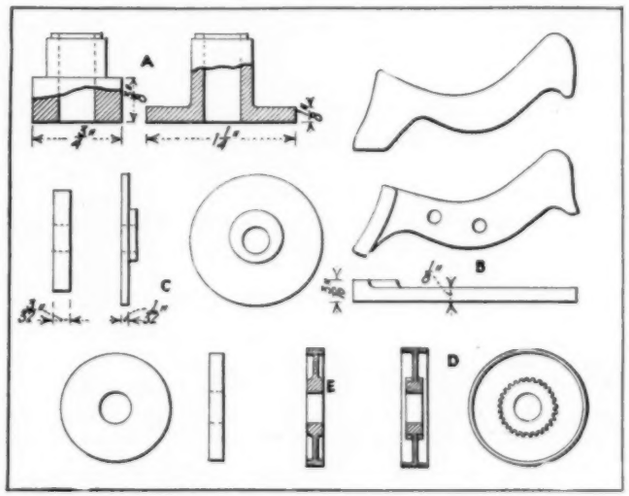


Fig. 5—Swaging is used extensively in making various forms of sheet-metal products and in many cases a substantial saving in material is effected. Various practical examples are illustrated to show its application

Various examples of swaging are illustrated in Fig. 5. Although the example at *A* does not represent a sheet-metal part, it does show the possibilities of swaging. The blank is a screw-machine product, machined to the sizes shown, which is in turn swaged so that the larger section is formed to a thin flange. A swaged part made of sheet metal, $\frac{3}{16}$ in. in thickness, is illustrated at *B*. The end of the blank is left at its original thickness and the body is reduced to $\frac{1}{8}$ in. Parts of this kind are made by blanking, swaging and trimming. Where an accurate contour is required, the parts may be shaved to size.

A sheet-metal part made in the form of an eccentric is illustrated at C. The blank is $\frac{3}{32}$ in. in thickness and is reduced to $\frac{1}{32}$ in., leaving at the center an eccentric as outlined. The foregoing examples have been applied to sheet steel, although the same principles can be used for other metals. An unusual swaging of an aluminum part is shown at *D*. The inner hub has a small spur gear on each side, the teeth of which are finished accurately between dies. At the left is shown the blank from which this part is made, and at *E* is shown the first swaging operation that gives the blank an approximate outline.

Bushings and tubular parts are often made from sheet metal at a substantial saving in material cost. In Fig. 6, at *A*, is shown a sheet-metal bushing formed from flat stock. The dies used for making a bushing of this kind cut the blank to size, then form it to a U-shape, finally forming the ends to make a cylindrical sleeve. The same process can be applied for the construction of tubing of various lengths. Another method of making a bushing is shown at *B*. The blank is drawn to a cup shape, and the closed end is cut off, producing a bushing of the desired size. No machining is required on a bushing of this type unless it is assembled in a frame to act as a bearing for a shaft. Used in this way, the bushing can be reamed at assembly. Another form of tubular work is shown at *C*, representing a square support. This part is made from sheet metal and is so cut out that it has a tongue to prevent misalignment.

Gears that can be made of sheet metal have the advantages of certain economies over those cut in the usual way. The relative size of the gears, the shape of the teeth and the material from which the gear is made, are usually the deciding factors. Accuracy in sheet-metal gears depends upon the type of die used. Sheet-metal gears made in dies have many practical applications, among them being for such units as cash registers, adding machines, typewriters and meters. Segments, sprockets, ratchets and racks can also be made by the same process.

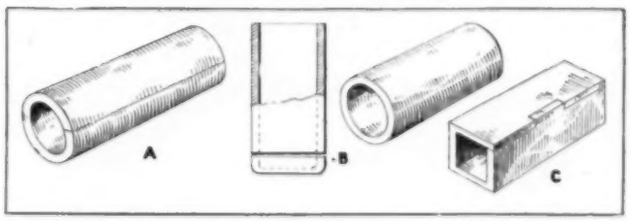


Fig. 6—Miscellaneous methods of constructing tubular forms from sheet-metal stock. Bushings can be rolled, or they can be drawn and finished by cutting off the closed end. Square sections can also be made of flat stock in either short or long lengths

Price or Service

"WHAT'S all this talk about buying 'on price?' Don't we all buy on price when you come down to facts?" It was Charlie Dodge, purchasing agent for the Laundry Machine Company, at a monthly meeting of the Chamber of Commerce. Charlie was smarting a bit because he had been accused of buying on price. "Don't we, Mr. Holland?" he added, turning to our counsellor-at-large.

"Trying to get me in wrong, right off the bat, eh Charlie?" replied Bill. "As with so many other things, it's largely a matter of definition. If you mean the first price you pay for an article, I'd say 'No!' But if you mean the amount the article costs us, in service, in satisfaction, and in results, then we all ought to buy on that kind of price."

"As if a purchasing agent knew about anything except the first cost," piped up Joe Downing of the Pump plant.

"Oh, they are improving, Joe, and a lot of them are just as keen on buying the best stuff as you are," returned Holland. "One trouble is that they don't often know what happens to a machine after they buy it. What would you say was most important in buying a machine, Joe?"

"Service," replied Joe. "Keeping it running after we get it. I'd rather pay a big price for a machine built by a good concern whom I know will back it up with good service than to save money at the start. After I buy a machine I don't want any more bills coming in to keep it running."

"You mean *free* service, Joe," said Charlie. "And that's one of the things Mr. Holland and a lot of others don't take to very kindly."

"Another case of definitions, Charlie," replied Bill. "If the service is necessary because of some fault in the machine itself, like a stuck bearing because someone forgot to drill an oil passage and the inspector let it slip past him, then it ought to be free. On the other hand, if the bearing sticks and scores because your man didn't oil it, then you ought to pay for the cost of the service. You'd be surprised to know how many thousands of dollars are wasted in sending service men from the factory to fix things that any average mechanic ought to see, and have in operation in fifteen minutes."

"It's a mighty comfortable feeling, though, Mr. Holland, to know you can send a wire and have a service man in your plant the next day. And, best of all, to know that it won't show up in the shape of a bill for the man with the check book to ask unpleasant questions about. I'd rather pay a high price at first and have it cover such cases." It was Joe once more.

"Seems to me," piped up Charlie Dodge, "that you're apt to pay a mighty high insurance premium to avoid a row with the treasurer. And if a manufacturer adds enough to his price to cover such cases, the man who doesn't need his service, as you seem to, is paying too much for his machine."

"Getting back to the cost-price question again," it was Holland this time, "isn't it a case of net, or *real* price, in the life of the machine? What we all want is the greatest *net* return on the dollar we invest, not only when the machine is new, but as long as it is in the plant.

"If that is what Charlie meant when he said we all buy on price, he's right. But, of course, we don't know until the machine wears out just what the net cost has been. So we have to balance the price asked for the machine, against the reputation of the builder for making good on his own errors, if any, and for reasonable charges for parts and other services."

"Well, I'm glad Mr. Holland has given you birds something to think about, too. I'm glad to have his slant on price," said Charlie.

"Don't forget, Charlie, that Bill doesn't mean only the first cost!" was Joe's parting shot as they separated.

Executives are invited to discuss the problem involved in the foregoing case. They are also urged to use this department to air their own problems. A letter to the Executive Forum Editor is all that is needed.

EXECUTIVE FORUM

Discussion

Overhead and Profits

The suggestion made by Mr. Holland that the manufacturer add into his overhead the two items of depreciation on his equipment, based on replacement value and not on original cost, and the going interest rate on his capital investment, is open to comment when considered from an accounting standpoint. In the first place, it is advocated that the manufacturer become more familiar with cost accounting, inasmuch as he shows a decided lack of knowledge of new points covering information vital to his business.

The ways in which cost accounting will help the business man are threefold: First, it will enable him to ascertain his manufacturing costs so that he may establish a selling price high enough to cover them and to allow the desired profit; second, to eliminate the waste incident to production; third, to guide him in deciding what products he should make.

Regarding the inclusion of interest on invested capital as an item of manufacturing cost, it is true that the subject has been debated time and time again, but the weight of evidence seems to favor the exclusion of interest from manufacturing cost. Of course, all costs must be included in the accounts. Those who favor the inclusion of interest among manufacturing costs use economic theory to support their contention. Those who oppose it emphasize rather the point of difference between economic cost and business cost.

The economic cost of an enterprise consists of the total payments made to production factors—land, capital, labor and the enterpriser. The respective payments are rent, interest, wages, and profits. Profits, according to economic theory, represents the difference between the selling price and the costs of land, capital, and labor; they are a reward to the enterpriser for combining the other production factors and for assuming the risk involved.

On the other hand, business or accounting cost is the cost calculated by the accountant from the books. For analytical and other purposes, the accountant subdivides the costs of production factors into a number of accounts, and he keeps the accounts in such a way that profit is not recorded as a cost, but is the result of a subtraction of costs from the selling price. The terms "economic cost" and "accounting cost," therefore, are not synonymous nor are they equal to each other in amount.

It is the general opinion that, although interest is considered in formulating policies, it need not be booked, because provision for capital is a financial proposition and has nothing to do with production of goods. A general works manager, it is contended, can be just as efficient with owned capital as with borrowed capital.

Another argument against including interest as a cost is that depreciation is a charge for the use of capital and hence no need exists for regarding interest as a cost for the same purpose. That is to say, to record both depreciation and interest is double treatment for the use of capital. Furthermore, since the business world regards interest and dividends as of the same general nature; namely, as a return on invested capital, the inclusion of interest in costs would produce misleading financial statements.

In connection with the inclusion of depreciation on equipment, based on replacement value, not on original cost, as an item of manufacturing cost, it is believed good practice from an accounting standpoint to consider the inclusion only in connection with the cost of the item to be depreciated, and not its replacement value. The fact that the value of the equipment has increased or decreased and that the cost of the replacement may be greater or less, should have no bearing on the amount to be set aside. However, if it is the intention of the management to purchase replacements costing, say, double the price of the original equipment without new financing, then amounts should be reserved for this purpose from surplus accumulated up to that time.

—HARRY KAUFMAN, *Public Accountant.*

The "Can't-Be-Done" Man

New viewpoints are always desirable in any line of business. The procedure followed by the newly appointed foreman in selecting young men as his assistants will be beneficial to the company, inasmuch as their attitude toward the work to be done will be different from that of the older and perhaps more experienced men, and the newer methods they will employ in meeting their problems may be more successful.

In the first place, the young men will bring fresh and unbiased ideas for performing the work. Their attitude toward the outcome of the job will be more optimistic than that of the older men, and therefore the success of the undertaking is more certain where they are employed.

To the older men, it may seem like a bit of egotism on the part of the young foreman to pick young men for his assistants, and reject the experience of older men, and it probably is as Mr. Holland says. But new methods should always be tried. Originality and initiative are essentials to the success of any undertaking.

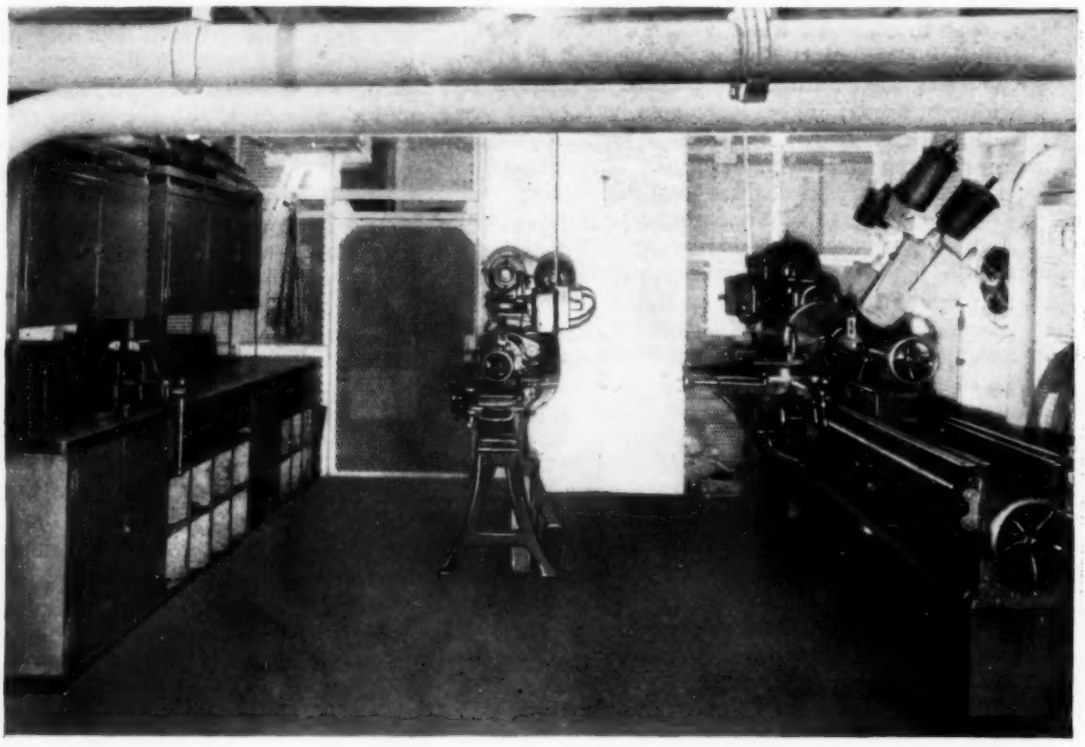
—JACOB BINDER.

A Sea-Going Machine Shop

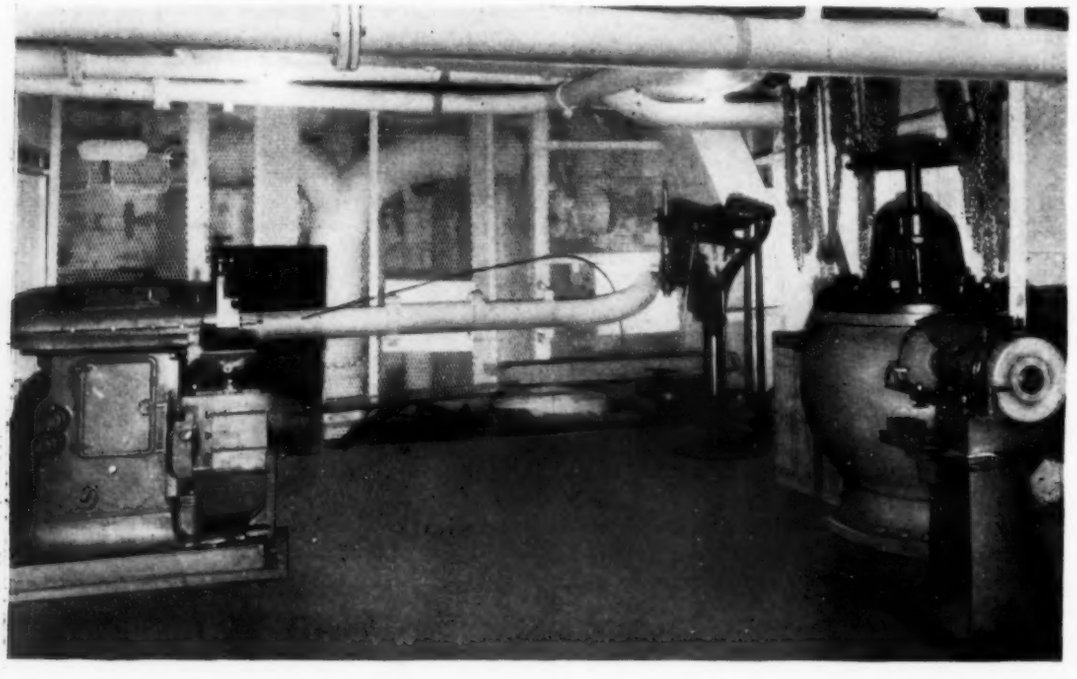
NO MECHANICAL failures are permissible in the modern steamship, which is in reality a complicated floating machine with its power plant, water and electric supply, refrigerating system, and other accessories that depend upon the continuous operation of machinery. The illustrations show two views of the machine shop of the S.S. "Virginia" of the Panama Pacific Line, that keeps the machinery in repair and continuous operation. This ship is the largest ever built in an American shipyard; and now runs between New York and San Francisco through the Panama Canal. It is equipped with immense refrigerating spaces both for cargo and ship-stores.

The machine shop hangs from the side of the engine room above the main condensers, and among the piping and valves, one of which, a 36-in. angle sea-valve is shown connected to the outer hull. Some of the piping can be seen in the lower illustration beyond the partition.

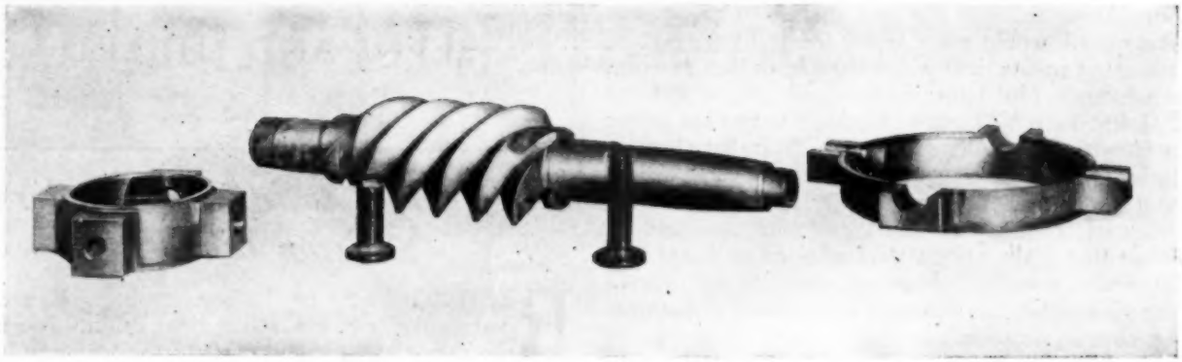
The equipment consists of one Rahn-Larmon 18-36-in. gap lathe, one South Bend 15-in. x 5-ft. lathe, one Steptoe 18-in. shaper, one Barnes upright drill, and one "U. S." double-head grinder, all motor driven.



The gap lathe shown has several features that differ from the standard engine lathe. The bed is in two horizontal parts, the upper half is normally tight against the head, but may be moved back by the handwheel on the tail transom. The brace shown under the carriage extension is to allow the tool to operate rigidly on the largest diameter within the capacity of the lathe



The work usually done in a shop of this nature is the renewal of valve discs and bearings, turning and straightening shafts, making piston rings, valve stems, studs, wrist pins, and similar parts, and occasionally a heavy repair job. An idea of the work can be judged from the fact that there are 3,000 power valves, and nearly 100 pumps and compressors, beside many other accessories, to be kept in repair



Typical parts for which the nitriding process is well adapted

Practical Applications *of the* Nitriding Process

By H. W. McQuaid
Metallurgist, The Timken-Detroit Axle Company

Nitriding has a field for those parts that do not give satisfactory results when carburized, and in certain services which require rustless qualities

At THE present time, although the nitriding art is relatively new and comparatively untried in this country, some very interesting applications have been made of it, and the possibilities for its future development are apparently very great.

Due to the cost of the special steel required for nitriding, the field of application at the present time is limited to those parts in which the results obtained from the cheaper carburizing steels are comparatively uneconomical. There is also a somewhat limited field of application where the non-corrosive properties of the nitriding steel allow it to compete with the more expensive stainless steels. A particular application of this would be the automobile water-pump shaft. Here the resistance to wear and corrosion offered by the hard nitrided surface makes it a desirable material as compared with the more expensive stainless steels used for this purpose. The losses which are met with in case-hardening steel, due to warpage, give the nitriding steels an advantage in some cases. Thus, in very complicated parts which tend to warp excessively in casehardening and which require considerable grinding to obtain the close limits desired, a nitriding steel can be used to great advantage, since the price of the steel is a very small part of the total cost.

At the present time, many kinds of articles have been nitrided. Gears are being nitrided in Europe on a commercial scale, particularly those used in automobile rear axles. In this country, however, results obtained with gears have not been altogether satisfactory, although many successful applications have been reported. The results with nitrided parts for such applications depends to a great extent upon how the article to be nitrided has been treated. Brittleness, which is characteristic of nitrided work in many cases, has been sufficient to discourage its use for many parts. This brittleness depends to a great extent upon the structural condition of the nitriding steel as well as its analysis. Molybdenum is supposed to be an essential element in eliminating or reducing the brittleness, but more important factors are the structure of the steel, and the amount of ammonia used in the nitriding process Thus, it has been found that a pearlitic steel, one which has been slowly cooled from above the critical temperature, is very apt to be brittle after the nitriding operation, especially if the dissociation of the ammonia in the retort has been high. On the other hand, a steel that has been quenched and drawn to give a sorbitic structure will, as a rule, give a nitrided piece which is tougher than a corresponding casehardened piece, providing the ammonia has been properly handled.

For this reason, all nitrided articles which are required to have any degree of toughness should be made from a steel which contains molybdenum, which has been quenched and drawn previous to nitriding, and which has been nitrided under conditions such that the undissociated ammonia has been held above 70 per cent. Under these conditions the toughness of the finished piece should be not only equal to, but much better than, a corresponding carburized piece, and it should be possible to bend a nitrided article much more than a carburized piece without complete fracture.

Tests made on nitrided worms from chrome-aluminum steel without molybdenum, nitrided at 950 deg. F. for

90 hours, show that the nitrided surface, while it was extremely hard, would crack under the rolling action of Hyatt-bearing rollers, and was very unsatisfactory from this standpoint. Molybdenum-aluminum worms nitrided at 1,200 deg. F. for 20 hours, although somewhat softer to the file than the lower temperature nitrided chrome-aluminum worms, after six months of severe service show no wear or breaking up of the surface under the Hyatt-bearing rollers. In this connection, it might be mentioned that plain carbon steel nitrided at 1,200 deg. for 20 hours, running in contact with the surface of 3.50-per-cent-nickel casehardened and ground differential pinions, showed no wear after six months of service, all the wear being on the casehardened nickel steel. Unnitrided plain carbon steel in the same service showed considerable wear in the same period of time with no wear on the pinion. If the nitrided article has been so treated that it has the required toughness, it is in every way superior to the carburized piece in that the nitriding can be performed on the finished piece without disastrous warpage, and the surface obtained is much harder and has greater wear resistance, as well as corrosion resistance, than the case-carburized piece. The process is cheaper, more easily controlled, and the time cycle need be little, if any, longer.

Many failures have been met with in nitrided parts, anl many failures will be obtained until the proper technique of nitriding is developed, but at the present time many parts ranging from thin pieces such as are found in a vacuum-cleaner beater bar, to very large sections, are being commercially nitrided every day with little or no difficulty or loss. Nitrided airplane motor-timing gears show much better life than carburized gears, and are more quiet due to the smaller amount of distortion. Nitrided valve seats for valves required to stand high temperatures are practically superseding other materials. Valve tappets and many other automotive parts lend themselves to the nitriding process. One of the largest fields, however, is the nitrided gear, which in this country has been practically untouched, but which will without a doubt in the next few years become of the greatest importance, since it is possible to develop a harder surface, more correct contour, and a stronger tooth in the nitrided gear than with the best modern case-hardening practice.

High Cost the Chief Obstacle

The obstacle in the path of quicker adoption of nitriding to replace most commercial carburizing where alloy steel is now used, is the high cost of the special steel. This also serves, however, as an impetus for intensive investigation into the development of cheaper nitriding steels and processes which will result, with the genius and pressure of the American industrial research laboratory, in the ultimate commercialization of the art.

An interesting and commendable item in the report of operating expenses of railroads in the United States, is the reduction in the cost of fuel consumed. The total of both coal and oil is given as $385,521,061, the notable point being that this is an appreciable decrease, due to increased efficiency of operation. Part of this increased efficiency is because of better equipment of the railroad shops. And there is still much to be done in many shops that would raise the efficiency to a considerably higher point. Better machine equipment is being appreciated more and more, and is a hopeful sign.

SEEN · AND · HEARD

By John R. Godfrey

Attempts to influence orders
Piston pin fits

RECIPROCITY, or back-scratching, to use the vernacular, can easily become a liability instead of an asset. As pointed out in a recent issue of the *Railway Age*, one of the large meat packing plants, in a letter to railway officials, tells of a subsidiary company controlled by it and says "we expect our railroad friends to use these articles on a reciprocity basis, with the understanding that they are competitively priced and their quality second to none." Being sent out on the company's letterhead it is very evidently intended to influence business with railroads over which its products are shipped. Preference for other makes of draft gear and other products is to be waived because of meat business. Is it to be expected that the packing company will ship its beef over railroads giving inferior or indirect service because the railroad uses its subsidiary's product?

In these days when we are talking about economical use of the best products it is discouraging to find such attempts at coercion along uneconomic lines.

* * * *

Piston pin practice, so far as fits in automobile engines are concerned, seems to be undergoing a radical change, particularly in the case of aluminum alloy pistons. It has been quite a common practice, owing to the fact that the expansion of aluminum is considerably greater than that of steel, to fit the pin very tight in the piston. This, of course, is with the idea that the piston will expand faster than the pin, and so give the desired fit when the engine warms up.

Present practice, at least in some well known instances, is to fit the piston pins more loosely than before. Instead of heating the pistons in hot water before inserting the cold pin, as was fairly common practice, the pin is fitted to a cold piston. Furthermore, the pin is not forced in, even by finger or thumb pressure, but is selected so as to just drop through slowly, by its own weight. This, after seeing the old practice, seems to be a loose fit—but it works.

Proof of this was shown in the shape of a set of pistons and pins taken from a car that had been driven about 30,000 miles with stops only for fuel, oil, and a fresh driver. The driving was at high speed all the way. Yet, after 30,000 miles the pins seemed to fit in about the same way, they just dropped through the holes in the piston, but without shake. In fact, the fit was better than in some that had previously been fitted in the heretofore standard way.

The only answer seems to be that the looser fits permitted better lubrication of pins and prevented wear that took place when the fit was very close. For, while a thin film of oil doesn't seem to offer much resistance to the blow of an explosion on the head of a piston, the time element probably prevents its being forced out, so that it really fills the space and actually keeps the metal surfaces apart. At any rate the fact that these pins fitted after 30,000 miles at high speed is worth considering.

Building Bus Engines in the *Lancia* Shops

By J. A. Lucas

Methods by which a triangular billet is forged into a shaft, and the operations in machining a six-throw crankshaft from the solid

CRANKSHAFTS used by the Lancia company in its bus engines stand out conspicuously as examples of parts designed for economical manufacturing methods through all operations from forging to balancing. Turning a heavy duty crankshaft from a hammered forging or billet is nothing new, but using a triangular billet has several advantages that will be pointed out.

The forging operation is simple, the only fixtures necessary being a V-block on the anvil and the usual flat upper die. The triangular shape forms readily from either the round or the square reduction, as the billet is broken-down, and only a single operation is necessary in the V-block as the corners of the triangle are not sharp, and the metal does not have to be forced down into the die. This shape of die is economical because after wearing it can be reduced in size either by machining it deeper, or in an emergency by a thin sheet-iron liner, loosely laid in. Using this method of forging makes the piece practically die forged, and so accurate that only sufficient excess metal for a normal roughing and finishing cut is provided. The billet used is nickel-alloy steel, and after forging it is normalized at a temperature of about 1,500 deg. F. to relieve the forging strains. Its cross-section assures the least possible amount of material, the least machining, and the least turning with an interrupted, or jump cut, which is an important factor in saving time in turning the main bearings.

After visual inspection, the forging is sent to the centering machine. This is an ingenious two-part affair clamped on the ways of an old engine lathe. The forging is placed in two V-blocks that can be moved up and down by means of screw-jacks at their bases. The fixture can also be moved laterally on its own base by means of a screw and ratchet, and can also be swivelled end for end. The advantage of the forging methods becomes apparent even at this stage. The forging is straight, has an even surface, and fits the V-blocks without shimming.

The centering head is a cleverly designed fixture and performs several awkward operations in a simple manner. It first acts as a gage for setting the forging so that it will clean up, and have an equal amount of metal removed from each of its three sides, after which it scribes the outside diameter of the crank web-throw, and then centers the forging ready for the lathe. This gage and scriber not only saves time in laying out, but also there is the added feature that as the gage cannot be adjusted it can scribe only one diameter, and subsequent checking is not necessary. The gage construction is as simple as its performance, the spindle of the centering head extends out beyond the front bearing about eight inches and is bored to receive a taper shank drill. A knurled sleeve, carrying two small upright posts, is slipped over the spindle and can be clamped or swung loose, as desired. The two posts, which are about 3 in. apart, and parallel with the axis of the spindle, carry a removable scriber which is held by a thumbscrew in one of the posts. Fig. 37 shows the arrangement quite clearly.

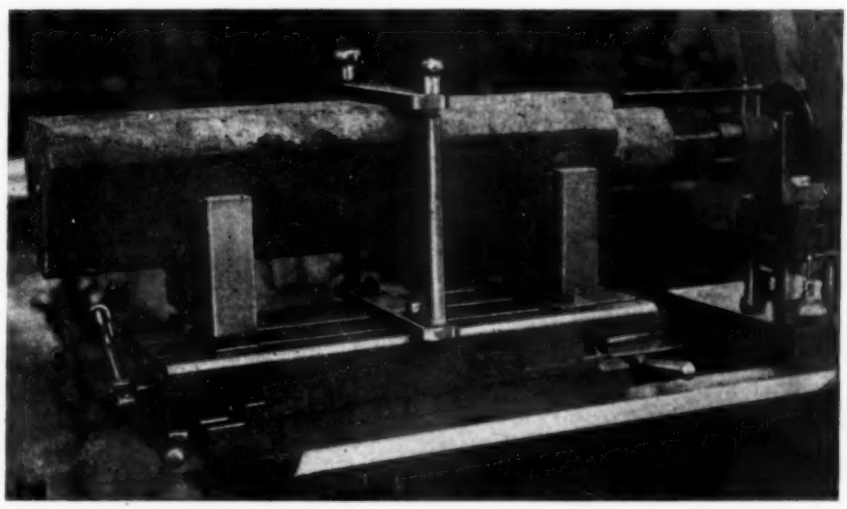


Fig. 37—Centering the triangular billet from which the crankshaft is made. The table is reversible so that both ends can be readily drilled at one setting

The forging is manipulated by the jacks until the gage shows equal metal on each of the three surfaces. The sleeve is then clamped and the centering head revolved by hand, scribing the segments of a circle on the three corners of the forging. The rod is then removed, the sleeve unclamped, and the end is centered. It is then swung end for end on its swivel, and the other end is laid out and centered. Inasmuch as one end is a plane

Conclusion of the article.

surface, it is not necessary to lay out both ends before centering one.

In a previous article attention was called to the operation and sequence sheets that are sent into the shop instead of drawings. The sketches shown in Fig. 38 are taken from the sheets covering the operations on the crankshaft. As sent into the shop they are sheets about 9x11 in. in size, and in columns from left to right contain the following information: Operation number, type of machine tool used, and its number, nature of the operation with the necessary jigs and fixtures designated by number, and last, a 2½-in. sketch of the operation to be performed. Only the principal operations are given. In the present case, 29 out of 51 operations are listed, and 24 sketches are shown. The operation number referred to throughout the article corresponds to that shown on these sheets.

The first machining operation is to turn the flywheel flange to $8\frac{1}{16}$ in. dia., and rough face the ends to length. The next one is to turn the outside diameter of the webs to $9\frac{3}{16}$ in., and the front bearing to $3\frac{3}{16}$ in., approximately. After this the shaft is sent to a chucking lathe with a spindle sufficiently large to take the body of the forging. A three-jawed chuck is built into the face of the spindle, and "V"-guides are fastened between jaws so that the forging registers correctly without shifting. At the rear of the spindle is an extensible live center, similar to that used in the old Lodge & Shipley, Marvel, shaft lathes. The forging is, therefore, carried on centers, and driven by the chuck jaws.

This arrangement allows the cut to be taken always near the chuck, and insures maximum rigidity with an accuracy in a single cut approaching a finish cut. The massiveness of the tool blocks shown in Fig. 39 show the cut possible. The tool holders are permanently aligned for both center height and angle of tool. The front one

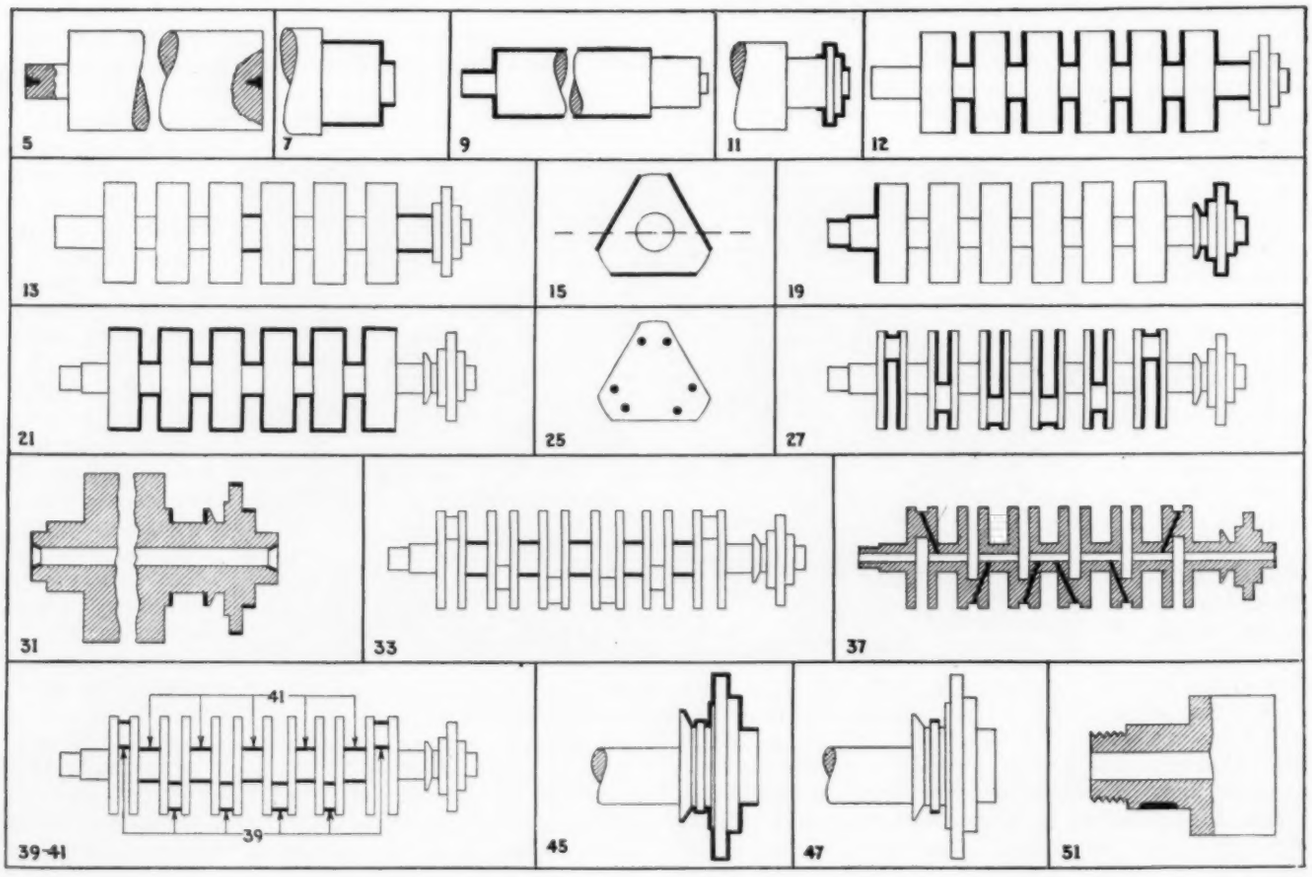


Fig. 38—Diagram of major operations and their sequence

1. Inspect forging
3. Heat-treat
5. Drill centers
7. Rough turn and face one end
9. Rough turn outside diameter, and face other end
11. Rough turn flange end
12. Rough turn bearings
13. Finish turn end and center bearing for fixture
15. Rough mill edges of crank webs
17. Heat-treat
19. Finish turn both ends
21. Finish turn main bearings
25. Drill flange
27. Finish faces of webs, and crankpins
29. Drill crankpins
31. Bevel ends of shaft, finish turn flange
33. Rough grind main bearings
35. Rough grind crankpins
37. Drill oil holes in webs
39. Finish grind crank pins
41. Finish grinding main bearings
43. Finish mill outside of collets
45. Finish turn outside diameter of flange, and rear end
46. Thread and chamfer front end
47. Thread oil flange
48. Ream holes in flange
49. File and tap
51. Mill seats for Woodruff keys
53. Straighten and inspect
55. Balance

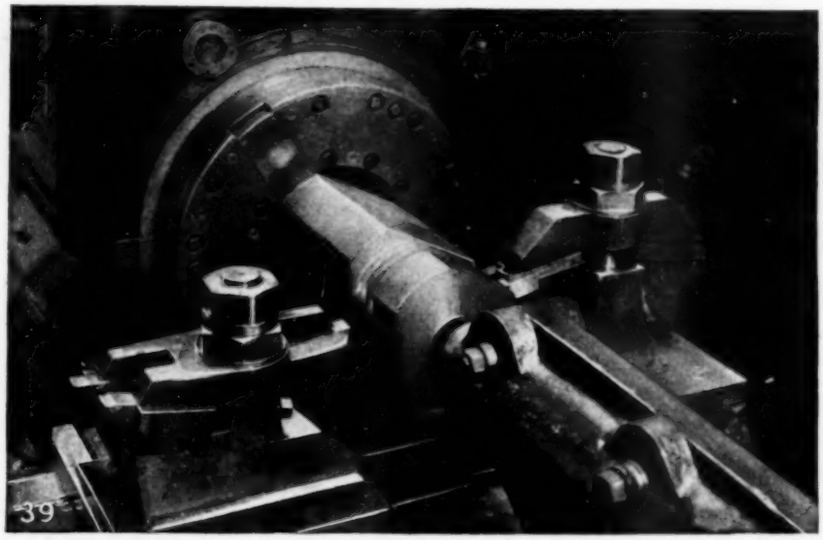


Fig. 39 — Turning the end of the crankshaft billet in a lathe with a large hollow spindle, showing special chuck to hold the work

Fig. 40—Milling the flat sides of the triangular webs between the crankpins. The fixture has side stops, as well as clamps at the bearings

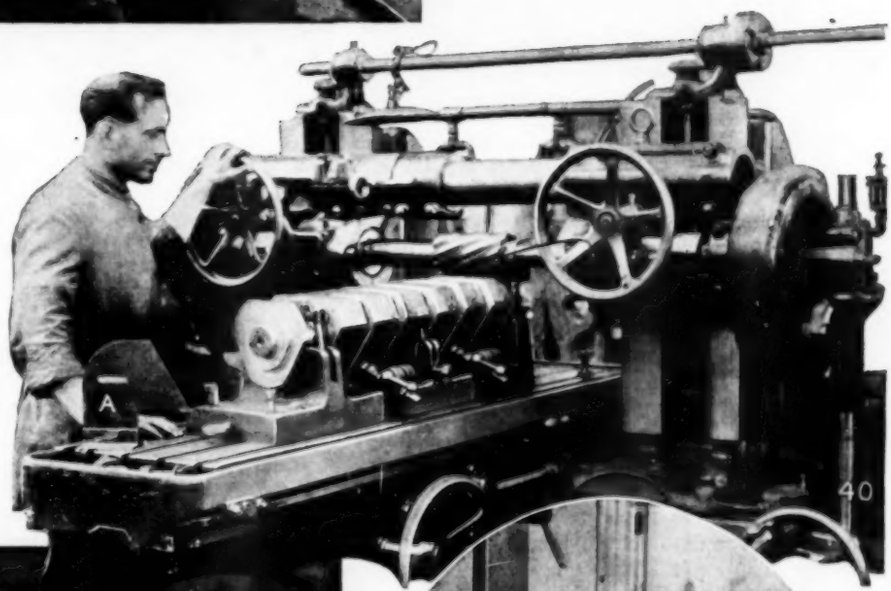
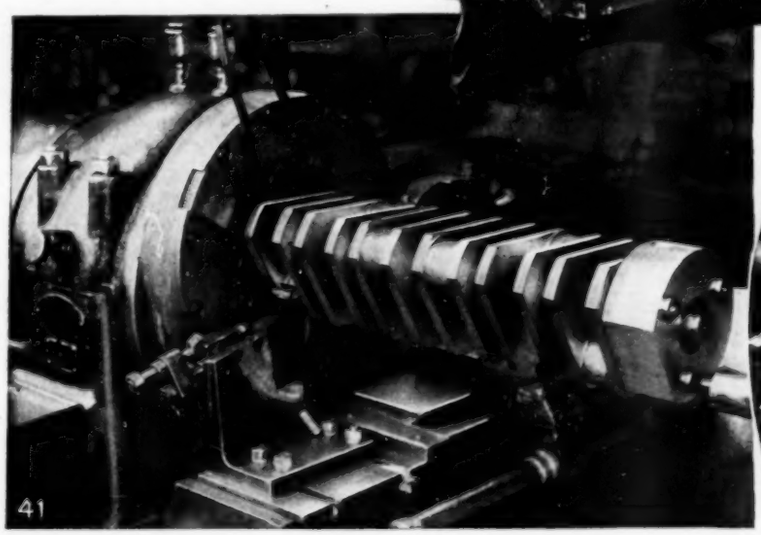


Fig. 41—Turning the crankpins. An offset chuck brings the crankpins in the center line of the lathe. A special back center is also provided for tailstock support



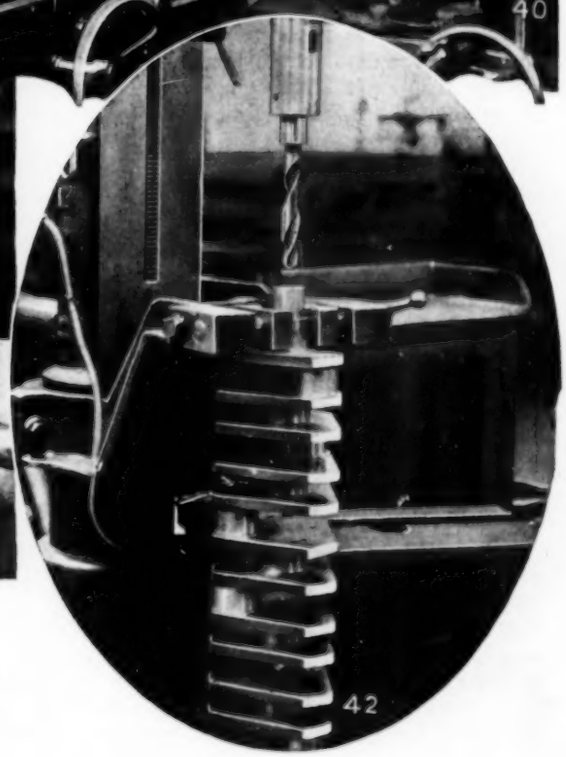
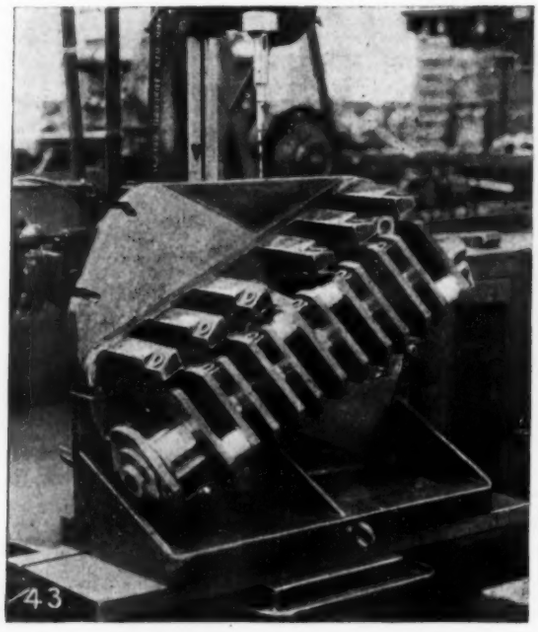


Fig. 42—Lightening the crankshaft by drilling a hole through the main bearings. The shaft is centered and held at the upper end



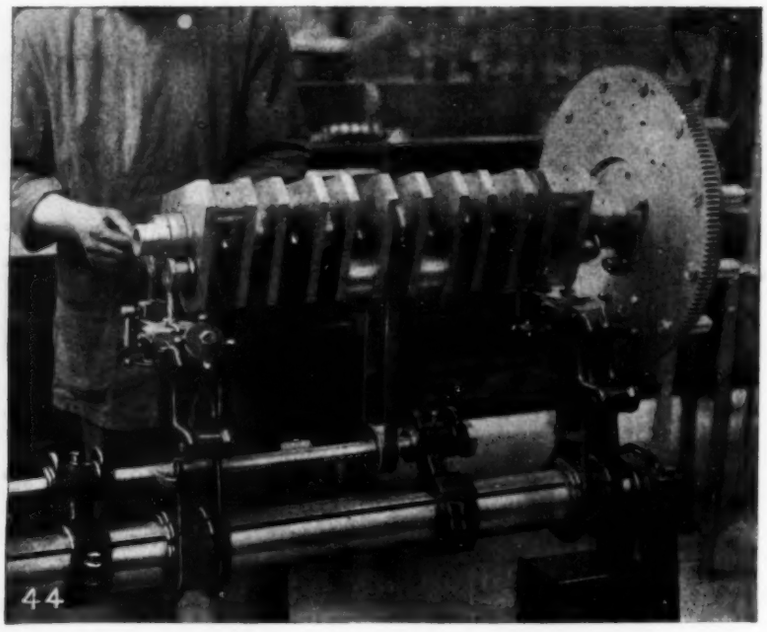


Fig. 43—Fixture for drilling oil holes from the main bearings to the crankpins, and also in the main bearings
Fig. 44—Balancing the crankshaft and flywheel assembly on a Norton machine

carries three, and the rear one four toolbits, all that are needed for the eleventh operation. The method of supporting the toolbits is noteworthy, especially the single break-down tool in the front block, and the simple method of preventing back-slip of the bits in the rear block.

In the same lathe the main bearings are roughed out, each bearing being turned near the chuck and the forging turned end for end after the center bearing has been machined, so that an equally rigid support is provided for both ends. Another advantage of the triangular design is evident in this operation. In a twisted forging it is necessary to take an interrupted cut on two adjacent webs until the diameter of the bearing is nearly reached. On the triangular shape a continuous cut is secured at approximately a 7-in. diameter, so that a faster and heavier cut is possible.

In the fixture used for operation 15, milling the flat edges of the triangular webs, the forging registers from the center and two end bearings. In this operation, which is shown in Fig. 40, the three edges are milled in a heavy Lincoln-type machine, and in order that the forging may be in balance, it is necessary that the three bearings be accurate and uniform. Operation 13 specifically takes care of this by finish turning these bearings to fit the fixture. Upon the accuracy of this operation depends the subsequent balance of the crankshaft, and precautions are taken to insure this accuracy. The gage shown at *A* is used for checking the angle and the fixture is self-centering after the first side is milled.

After the milling operation the crankshaft is sent to the heat-treating department, where it is heated to 1,560 deg. F., quenched, normalized to 1,200 deg. F., and quenched in oil. It is then returned to the lathe department for the various finishing operations from number 19 to 25, inclusive.

For operation 27, rough turning the crankpins, a hollow spindle lathe of the same general type that was employed for turning the main bearings, is used except that the spindle is eccentric to its bearings by the distance of the crank throw. This is a more expensive equipment than the usual centering disk on each end, but a glance at Fig. 41 shows that the toolpost is rigid, and that the tool takes a heavy cut about 2 in. wide. The chips can be seen on the tool and beside it. Inasmuch as the centering disk will fit on only one end of the crankshaft, it is not possible to turn it end for end, but the cut is taken as close to the chuck as possible, the crankshaft being fed out as required. As the chuck is eccentric, the shaft must be turned in it for each of the three crank positions. The center inside of the spindle makes this easily possible.

The main bearings of the crankshaft are hollow. This operation is performed on an upright drill as shown in Fig. 42. The table and its arm are removed, and a fixture clamped to the column in their place. The fixture consists of a vise with two self-centering jaws. A large lathe center is used in the base of the drill press to insure alignment. In a previous operation, No. 23, the ends of the shaft have been counterbored to insure the drill starting straight, and it is then reversed after one end has been drilled. After the drilling operation, the crankpins and main bearings are rough ground.

The next operation is to drill oilways through the web from the crankpin to the main bearing. This is done in an upright drill using a three-position swivel fixture, as shown in Fig. 43. The crankshaft registers from its bearings and can be turned on them, so that the six necessary drillings are obtained without trouble. The next two operations are finish grinding the crankpin and bearings, respectively, after which the edges of the webs are finish milled, and the flange for attaching to the flywheel is finished. The last machining operation, No. 51, is milling the seats for Woodruff keys. After a general inspection the crankshaft is sent to the Norton balancing machine shown in Fig. 44. As all of the operations are symmetrical, this operation is largely a check.

Visualizing the Stresses in Gearing

By H. L. Bradford

THE tension stresses in the teeth of gearing under load may be determined quickly and accurately, by means of the simple polariscope shown in the illustration, which was built and used at the Westinghouse Electric & Manufacturing Company. The device consists of two boxes *A* and *B* on the same base, a source of light *C*, two pieces of black glass, *D* and *E*, and a means of applying force *P*.

Any shape that can be represented by a uniform cross-section model, and made of pyralin, celluloid, or similar material, can be tested. In the case of gearing, model teeth of actual size are made of ¼-in. pyralin. When pressure is applied between two teeth, stresses are set up in the pyralin that have the property of changing the relative velocity of split polarized rays, resulting in a color, varying with the lag between the two parts of the ray.

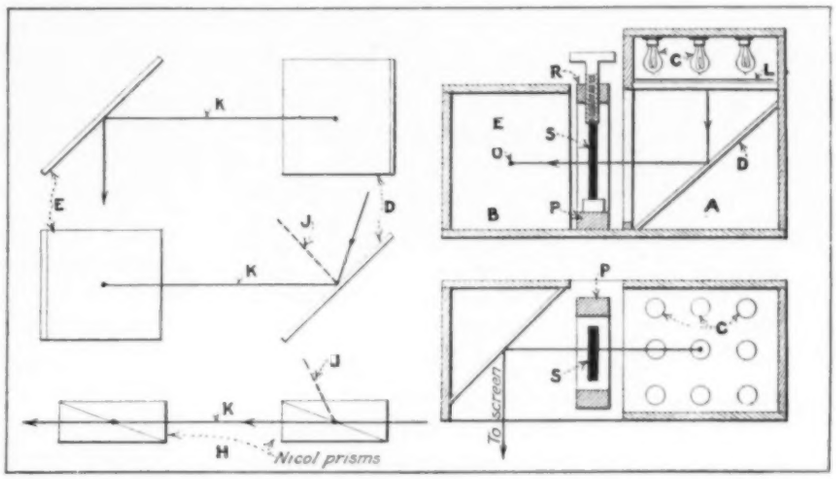
To build, or operate the device successfully, it is necessary to understand something of the principle of its construction. A laboratory polariscope uses two Nicol prisms, which are simple quadrangular prisms split as shown at *H*. A ray of luminous light directed upon the prism, breaks into two rays called an ordinary ray, *J* and the extraordinary ray *K*. The ordinary ray *J* is diffused and lost in space. The other ray *K* is projected at the angle of incidence into the second prism called an analyzer, and is then called polarized, or unidirectional light.

In the device under consideration the polarizer, and analyzer are pieces of glass blackened thoroughly on the under side. Light is furnished by several ordinary lamps *C*. It is diffused by a sheet of ordinary tracing cloth *L*, and impinges on the blackened glass at *M*. The ordinary ray disappears into space and the extraordinary ray is reflected to *O* on the analyzer *E*.

Placed between the polarizer *D* and the analyzer *E* is a holder *P* and a means of exerting pressure *R*. If a model is held in this holder without tension, the ray *K* on its way from *D* to *E* passes through it and is again split up. Both these rays are of equal value and velocity, but have a space phase of 180 deg.; in other words, one neutralizes the other, and no light is reflected from the analyzer *E* to the screen.

When stresses are set up in the model *S* the direction and frequency of the two rays remain the same, but their wave length and relative velocities are changed, and they are out of phase.

Two rays out of phase, or in other words, out of step, project a color on the screen. The color varies with the amount the two rays are out of phase, which in turn is caused by the degree of the principal stresses set up in the model *S* that they pass through.



Left—Ordinary white light is changed to polarized light by being projected from black glass at right angles. The Nicol prisms split diagonally projects it as a parallel beam. Right—Boxes showing arrangement of lights and glass projectors with the model holder between.

The relation between stress phase lag, and color being definite they can be charted as shown in the accompanying table.

This simple outfit offers a means for obtaining useful information regarding the distribution of stresses. It is suitable for demonstration purposes in industrial work, or engineering schools.

Colors Produced in a Simple Tension Member Machined of ¼-In. Thick Pyralin

Color	Tension in Lb. per Sq.In.	Color	Tension in Lb per Sq.In.
Black	0	Dark green	1050–1200
Gray	0– 70	Light green	1200–1400
Gray-yellow	70– 195	Greenish yellow	1400–1500
Cloudy yellow	195– 340	Clear yellow	1500–1630
Yellow	340– 500	Orange	1630–1750
Gold yellow	500– 700	Brick red	1750–1860
Orange	700– 800	Rust red	1860–1940
Brick red	800– 900	Brown	1940–2000
Rust red	900– 920	Dark green	2000
Brown	920–1050		

What Is a Slot?
Discussion

By H. D. Scoville

IN ANSWER to John R. Godfrey's question published on page 202, Vol. 70, of the *American Machinist*, I submit the following definitions:

A slot is an elongated hole cut clear through the piece. It may be straight, curved, or of any shape such that the axes are not equal in the plan view. It may not necessarily be of the same dimensions all the way through. It is primarily for the passage through the piece of various shaped bolts, studs, shafts, etc., and is elongated to provide adjustment of either piece along the major axis.

A recess is any depression below the main surface, but when it becomes a long channel it is more properly a groove.

· THE · FOREMAN'S · ROUND · TABLE ·

The following narrative is a "case" presentation of the topic. It has been written to involve some of the questions that arise in the average shop. For guidance in preparing discussion the questions at the foot of the page have been prepared

Shall Men Clean Their Own Machines?

"WILLIAMS tells me he ran into a new method of cleaning machines, on his last trip," remarked Al, as he and Ed were heading for the train.

"What's new about cleaning machines? Doesn't seem to be much chance for improvement there."

"It's new, anyhow, Ed, whether it's an improvement or not. This was a big shop with lots of machines. They had rigged up a small, oil-fired boiler on wheels and fitted it with a good hose and nozzle so they could blow steam on the dirt and grease of the machines. Williams said it did a fine job of cleaning. Took the grease off in no time."

"Doesn't sound so good to me, Al. In the first place, I'd think the steam would rust up the machines. And next, I don't like the idea of a machine being cleaned by anyone but the man who runs it."

"There may be something in the first objection, although Williams said there didn't seem to be any trouble from that source. But your last crack sounds sort of funny to me. Are any of your men so fond of cleaning the grease and muck off their machines that they'd quit if you sent someone else to do it?"

"I'll admit it isn't a pleasant job, Al, but it's a lot of satisfaction when you get it done. And then, too, don't you think the man who runs it ought to know it is in good condition? Shouldn't *he* be held responsible for its condition?"

"There may be room for argument there, Ed, but I'm for the 'cleaning crew' just as much as for the floor sweeper. Where the man cleans his own machine, he quits work a quarter or half an hour early, once a week, and you lose that much production. With the cleaning crew he works full time and the cleaners come on after shop hours. And I don't believe he's keen on cleaning his machine either."

"But doesn't a good man take pride in keeping his machine clean himself? Do you know of any place where the operator isn't responsible for his machine?"

"Sure thing, Ed. The locomotive engineer has a pretty responsible job, and in the old days he and the fireman cleaned and oiled the locomotive—took all the responsibility. But do they fuss with that now? Not any! They come in from a run, step off the locomotive as soon as it gets to the round house, check out on their time sheets, and go home. They don't clean the engine, or oil it, or do anything but run it. Most of them couldn't repair a locomotive if they tried. Why can't it be the same with a lathe or planer man?"

"Maybe you're right, Al. But it seems like I'd rather have my men clean their own machines."

Should the men be responsible for their machines as Ed suggests? Is this a real point in the shop today? Is Al right about the effect on production and the men?

All foremen are urged to discuss these questions vital to their work; of course the

discussion is not limited to foremen. Letters accepted and published will be paid for

Discussion of Earlier Topics

Spending Money for Oiling Equipment

THE question of oiling systems is one that is agitating the machine operating industries to a considerable degree. If it were a simple matter of comparing the cost of the time spent by the operator or special oiler in lubricating a machine for a year against the capitalized cost (including depreciation, repairs and service) of an automatic oiling system, perhaps many an expensive oiling system now in use would never have been installed. But the automatic oiling system is dependable, while human service is not, and it becomes a question of just how much the insurance value of avoided breakdowns, tie-ups and expensive repairs is worth.

It reduces itself once more to the rather indeterminate human equation. One of the best cartoons of a comic artist who specializes on machine shop backgrounds shows an old man with an oil can squirting oil into the lathe center hole in the top end of the shaft of a drill press. Replying to a question, he states, "Why, I've been oiling that hole for eighteen years." Of course, it is absurd, but it probably happened just the same. So as long as you have the possibility of such human service, the automatic oiling system, no matter how expensive, is a good investment. —JOHN W. GARDINER.

Does Appearance in Tools Count?

WHILE it is not necessary to make tools, jigs and fixtures with a finish suitable for piano ornaments, yet they should be finished so as to make them presentable and safe for workmen to handle.

Any tool or fixture with edges too sharp, or coarsely finished surfaces, presents a hazard to the person using it. Tools in general must be accurate to the needs of the article for which it is made, and finished to such a degree, that it will be discernible on the shelf when not in use, and also cause it to be handled without injury. Why have parts of the tool machined to a fine accuracy and leave the remainder like a section of junk? Surely, to finish a tool to a certain extent is economical, even in these days of rapid production.

—F. E. BIRD, *Foreman, England.*

THE finishing of tools and dies has been carried to extremes by some toolmakers. Everyone in contact with production has seen instances of damascening and other forms of fancy finishes on tools of various kinds.

There is no excuse, however, for swinging to the other extreme of constructing tools that look like an assembly of junk. The cost of special tools is an important item to every production shop, and in this connection it must be borne in mind that the cost of a tool is the sum of the costs of its design, construction and maintenance.

Every toolmaker worthy of the name takes pride in the appearance, as well as the performance, of his product, and the encouragement of this craftsman's pride will ultimately be reflected in the quality of the product.

—CARL E. SCHINMAN.

THE · NEXT · TOPIC

An Unemployment Fund

ADVANCE QUESTION

Williams has told Al about a concern which has a fund for helping employees financially when it is necessary to lay them off. Do you think that such a plan is practical?

More Responsibilities for the Foreman

A GOOD foreman makes it his business to remove all the obstacles that stand in the way of his men in order to leave them free to do their jobs. The foreman who is most successful in removing the obstacles which prevent the full exercise of a workman's ability is rendering a real service.

The foreman helps a man when he sees that his machine is in condition to turn out good work, and when he plans the movement of materials through the shop so that the man will not have to stop his work and hunt for material. He further helps the workman when he issues the necessary orders for tools and follows up his orders so that he can get them to the workman before he is ready to use them, and when he keeps the necessary supplies on hand, a lack of which would compel the man to quit work, and also when he gives him the necessary instructions as to what he is to do, and when he is to do it.

These are some of the responsibilities of the foreman to his men, and properly carrying them out, the foreman can prove to be a great factor for creating goodwill and cooperation between worker and management.

—PETER DE PASQUAL.

Finding New Ideas on Shop Visits

WILLIAMS' idea of requiring reports of visits from foremen is fundamentally correct. It is in fact sound business for a report to be required from everyone, apprentice, or chief engineer, for every extraordinary item of expenditure. Written reports are valuable as a record of something done.

We all tend to mistake a hazy mental picture for exact knowledge. We know what our room looks like, yet

how many can describe it exactly to a person who had never seen it so that he would recognize it when he did see it? It is part of an executive's job to conjure up such a clear idea of what is wanted in the minds of others that they can co-operate intelligently. A report should convey a mental picture from one individual to another. —H. JAMES, *England.*

The Boss's Son in the Shop

IF THE boss's son goes into another shop he will be treated as others are, he will learn to depend on his own efforts and not on his father's position. He will gain broader views, and may be able to introduce to his father's works new ideas and methods. He will learn to understand men, and so be able to deal better with labor in the future, and also learn to get on with fellow apprentices who are of the class from whom he will later draw his salaried officials.

On the other hand, in his father's plant he can learn faster and more easily, if he is made of the right stuff and will work hard. His shopmates, and especially first class men, will go to some pains to give him more and fuller information. The foreman will give him better teaching and will take pains to instruct him. He will have increased opportunities to learn something of works management, and will learn more of the difficulties of running the plant. When he goes to the drafting office he will receive greater attention and the head will keep an eye on him and see that his technical education runs in the right channels. The same will apply in the other departments that he passes through, and throughout his father can keep an eye on his progress, and generally supervise the course of his training.

—F. W. OLIVER WHITE, *England.*

Getting Ideas from Other Shops

THE two ideas cited are certainly well worth while, and while the one about welds is not applicable to our line of work, the one about using machine oil with the kerosene will certainly find use in our shop from now on. Practical ideas such as these are not things of the moment, but become part of the shop practice of the organization, and reflect the benefit of the inspection trip on which they were acquired.

However, when we ask the inspection trip to justify itself on directly applicable ideas alone, are we not overlooking its major value? Any work that is not purely routine depends upon the functioning of the mind for a great deal of its success. It is my opinion that if he did not garner one tangible idea, the shop foreman who has shown enough initiative to get that job, would still receive enough indirect mental stimulation to justify the expense. —A. A. CROWELL.

IT IS a sound investment to send a good man, preferably a foreman, on an "idea gathering" trip. We were experiencing trouble in our hardening department, and told the foreman that he had better plan on visiting a few places which did work similar to ours and get their ideas. His trip expense account was $126, but he came back feeling that he amounted to something to be sent on such a mission, and he got what he was looking for—the other fellow's methods. As a result we now use oil burning muffle furnaces with temperature indicators and get splendid results on the work where we had trouble.

—CHAS. H. WILLEY.

EXPERIENCE and observation lead me to state that seldom does a foreman visit another shop without observing some new idea that it will pay him to apply in his own shop or to his own problems. It may be some special labor-saving tool, or an improved method of handling material. I have often been sent to other shops in different parts of the country to inspect their equipment and operation with a view to obtaining better results in our own shop by introducing effective production methods. Immediately on my return, a report has to be made to the plant superintendent. Why should the foreman not answer questions or make a report of what he observed on his shop visits?

—E. ANDREWS, *Foreman, England.*

THE idea of gathering information from the other fellow's shop is fine, provided that the giver is perfectly willing. Is it not probable that if it became a common practice to send out men on trips for no other purpose, that receptions might be cool at times?

It is natural that the best ideas would be found in competitor's shops, and a visitor might be made to travel a path that appears well but where little of value would be seen. The visitor could not gracefully ask to see a given process or mechanism he might know of. A visit of this kind would be of little value and surely would not make the visitor feel that his time was well spent.

—L. F. SWANSON.

The Foremen's Ideas on Pensions

THE payment of a pension finds justification in the fact that a man who has worked for a firm has given his time continuously for a long period of time, without the possibility of giving that time elsewhere. He has acquired skill in doing his work well, but his skill is unavailable after a certain age. Society ought to pay the price of his specializing. Economically, the minimum wage law is not justified, perhaps. So, economically the pension may be undesirable; but socially, it is useful. —E. SIMONSEN.

THE average shop man will probably tell you, if a pension system is suggested, even though he is not charged directly to contribute financially to its establishment or maintenance, that he'd rather have the company put the money it costs into his pay envelope. For if they did, wouldn't he buy insurance, which would not only protect him as far as his old age was concerned, but also his family? Quite an argument, the only flaw being that no matter how much his wages might increase, this same man never does buy the equivalent insurance.

So, if we find that in order to protect the weak it is necessary to include everyone under the same provisions, in passing national or state laws, isn't it reasonable to assume that the pension system is logical on the same basis? It is the fairest, most direct, and most reasonable way of protecting the worker in his old age in spite of his own failure to provide for himself.

—H. B. ERSLEY.

German and Skoda Tolerances Compared—*Discussion*

By Dr. N. N. Sawin
Research Engineer, Skoda Works, Pilsen, Czechoslovakia

Changes in certain tight fits, and closer tolerances for the small diameters are necessary—The close tolerances on the large diameters are meaningless

THE principles of the Skoda system of tolerances and allowances for machined fits, which system has been proposed for the Czechoslovakian standard, have been discussed in a number of periodicals, including the *American Machinist,* page 721, Vol. 67. As the underlying basis of this system corrects the D.I.N. *(Deutsche Industrie Normen,* German Industrial Standard) system in numerous points, it is quite natural that certain leading Germans have manifested the keenest interest. The German Industrial Standards Committee acts, as is well known, as secretary of the International Standards Association in questions relating to the tolerance systems of the whole world. The release of the independent Swedish tolerance system recently confronted German industry with the question of reducing its own tolerances. This was settled in 1927 by changing the fits in the precision *(edel)* grade, and the secretary now intends to propose the D.I.N. system for international acceptance. The Skoda tolerance system is another indication of some imperfections of the D.I.N. system. It points out shortcomings so serious in character, that their rectification endangers the passungseinheit (P.E.) unit of fit, which forms the basis of the whole D.I.N. system. (The passungseinheit=1 unit of tolerance $=0.005\ \sqrt[3]{D}$). The proposed Czechoslovak standard (the Skoda system), was mailed to the secretary of the International Standards Association at approximately the same time that Professor Schlesinger received from me an article about the Skoda system for publication in *Werkstattstechnik.*

Professor Schlesinger, who already intended to devote one copy of his publication *Werkstattstechnik* to tolerance questions, mailed a copy of my article to a large number of German machine concerns with the request that they express themselves not only about the basic principles enumerated in my article, but also about their experience in general with the D.I.N. system as regards economical production, and technical suitability of the Passungseinheit as the basis of the D.I.N. system. Leading engineering experts from fifteen important German concerns, who have used the D.I.N. system over a more or less extended time or who intend to use it in the near future, to the question whether the D.I.N. system is satisfactory and whether the changes suggested in my article are desirable, made a unanimous reply that the D.I.N. system is entirely satisfactory. Some authors mention that in the practical application of the D.I.N. system they met with the same difficulties as the Skoda Works, but that they have been able to eliminate them by a more perfect organization, and by educating the designers and workmen. All of the statements were published in the *Werkstattstechnik* for April 15, 1928. They may be divided in two parts, one of which refers to the numerical values, and the other to the theoretical basis and derivation of the Skoda tolerance system. If we limit ourselves to the theoretical part, for the sake of brevity, the following questions remain to be discussed:

Dr. George Schlesinger recently conducted a survey of German industrial leaders to determine their experience with the German tolerance system. The results were summarized in the *American Machinist,* page 725, Vol. 69. Dr. Sawin now completes the European side of the discussion by presenting the reasons why his country opposed the adoption of German (D.I.N.) standards

(a) The correctness and necessity of changes in the medium force *(fest)* wringing *(haft),* and tight *(treib)* fits.

(b) The dependence of numerical values of tolerances on the diameter, and the question of economical production.

Changes in the Medium Force, Wringing, and Tight Fits

In almost every contribution either directly or indirectly the possibility is confirmed that instead of a medium force fit, fine grade, a fit with a positive clearance may be obtained. To avoid this drawback the following working methods are recommended:

1. Instruct the workmen to work closer to the "go" side of the gage.

2. Transition to medium force fit, precision grade, or to a combination of fine fit and precision grade.

3. Selective assembly.

The first method is nothing less than a return to working to standard gages, and is resisted by the workman who does not count as scrap work which is within the limits of the "go" and "no go" side of the gage. The second method requires that these fits always be executed in the highest grade, which does not give economical production. The third method is only possible in quantity production, and does not guarantee interchangeability of parts.

The reasons for the medium force fit, fine grade, of the D.I.N. system, as enumerated by chief engineer Mauderer of M.A.N. (Maschinenfabrik Augusburg-Nuremberg) are based on using the medium force fit as a tight fit. This does not agree with the established definition of a medium force fit, which is a tight fit whose components can be assembled or dismantled under all circumstances only by the application of force. Views similar to Mauderer's are presented by some of the other authors, and if his view should prove to be correct, the D.I.N. system would be lacking an established term for a medium force fit in the fine precision grades. To this we may add that the same rectification of the D.I.N. system as provided for in the Skoda system has been carried out in the systems of Sweden and Switzerland, countries with industries of world-wide reputation.

Ambiguity of Definition

Chief engineer Muller, speaking for the A.E.G. (Allgemeine Elecktricitates-gesellschaft, Berlin), in order to confirm the correctness of the medium force fit, fine grade, refers to thousands of these fits per month in the manufacture of small electric motors. However, we are sorry to state that he does not mention by which of these methods the results have been obtained. When a limited number of machine types in large lots is produced by workmen educated and experienced in a certain way, these statements are quite natural and comprehensible. In the same article, however, the author admits that for small lot and individual production the shops are selecting work with micrometers. The medium force fit of the Skoda system does not require this assistance.

The wringing and tight fits, in consequence of this lack of definition, are very little discussed in the expressions from German industry. To insure the characteristics of these fits, most likely the same methods and means are used as for the medium force fit that is transition to fine grade working to the "go" side of the gage, and the use of micrometers or selective assembly. We are unable to understand why the representatives are unwilling to acknowledge the undoubted perfection of these fits in the Skoda system, as well as in the Swedish system, by which the amount of scrap is limited. There are no objections to press fits. The expressions only confirm the conclusion that these fits cannot be solved by dependence on a cubic parabola, and furthermore that the D.I.N. system of tolerances for the press fit is good only for certain conditions, and therefore should be used only as a guide.

Most of the contributions expressed themselves against a reduction of production tolerances in small diameters and against an increase of tolerances in large ones. However, opinions which are diversified to such an extent may serve as a proof that a universally accepted basis for the defense of $\sqrt[3]{D}$ is non-existent. A whole series of facts, partially enumerated by the authors themselves, confirms the correctness of our procedure.

The German industrial standards committee has recognized the necessity for reducing the production tolerances of the shaft, and this was carried out by changing the precision grade tolerances in March, 1927, from 1 P.E. to $\frac{3}{4}$ P.E. This confirmed also the possibility of carrying out the reduction. The committee extended this reduction to all diameters up to 500 mm., preserving however $\sqrt[3]{D}$. In actual practice work above 200 mm. is seldom produced to limit gages. When we compare the values of the corrected D.I.N. precision grade with the Skoda precision grade which was worked out in March, 1926, and released in August, 1926, we note that there is a marked agreement.

Apart from consideration of how impossible and unreasonable from an economic standpoint is the reduction of tolerances in the small diameters the contributions contain the following hints on how to carry out these reductions in actual practice:

1. Work with dial indicators, and reduced tolerances (chief engineer Bartholdy of Krupp A.G.).

2. Work to mean dimension of the tolerance using micrometers (Muller of the A.E.G.).

3. Work to the "go" side of the gage (chief engineer Mitan of Fritz Werner, Porsch Daimler).

In addition to the above, Muller of A.E.G. states that when using the fine grade, the variations in production remain within the limits of that grade. Chief engineer Gartner (of S.S.W.) plots diagrams of ground shafts, from which it is manifest that only one-half of the total tolerance is utilized. Accordingly, there are no serious objections on the part of representatives of German industry against the reduction of tolerances on shafts. It may be added that up-to-date grinders permit a cheap quantity production of shafts with very close tolerances.

The production of bores with close tolerances is considerably more difficult, but may be accomplished by means of reaming which is not an expensive operation. A reduced tolerance means a shorter life of reamers. However, this may be compensated for by the use of adjustable reamers. The development of precision drills and internal grinders makes cheap production of exact bores possible. Examples quoted by chief engineer Gartner of S.S.W. as a proof of inexactness in the production of 30-mm. dia. bores cannot be considered as representative of exact reaming. Such deviations from geometrical shape are not admissible in the fine grade. But, if we accept this inexactness in production, and deviation from geometric shape as standard, then, tolerances of 25μ (1μ = 0.001 mm.) for 180 mm. dia., and 45μ for 800 mm. dia., cannot be maintained. Dr. engineer Kuhn's remark about the possibility of reducing tolerances applies equally to external and internal grinding. Note that up-to-date grinding machines and methods combined with modern measuring methods, enable close tolerances to be maintained without difficulty.

In view of the above I cannot agree with Professor Schlesinger concerning the considerable increase in production costs going with decreased tolerances, nor with the example quoted by him that the reduction of tolerances (50 mm. dia.) from 25μ to 20μ will cause an increase of 50 per cent and more in costs. In any case

these figures do not speak in favor of correcting the tight fits and the interference and transition fits, fine grades, within the limits of the D.I.N. system, as, for reliable fits, the precision grades must be used, and this means, for instance within the 50- to 80-mm. range a reduction of tolerances from 30μ to 20μ, against 25μ in the Skoda system. In other words, according to the figures of Professor Schlesinger rectification of these fits within the D.I.N. system would cost 50 per cent or more over the cost of rectification according to the Skoda system. All the data about difficulties in the production of small bores demonstrates that shops should be given an opportunity to work as much as possible in the "medium" grade, which demand is satisfied in the Skoda system by the third grade.

Limitations in Measuring Large Diameters

As to large diameters, we find no objections based on facts derived from the use of the D.I.N. system when limit gages are used. It is beyond dispute that, by a greater expenditure of time and money, a relatively smooth surface and a sufficiently correct geometric shape may be obtained on large diameters. However, the measurement of large diameters takes place under quite unfavorable conditions and the correct determination of the actual diameter is very difficult. Therefore, in production with limit gages it is impossible to speak about thousandths of a mm. on diameters above 200 mm. Checking of snap gages, for larger diameters (200 to 500 mm.) as manufactured by specialists, has shown that, in consequence of elastic deformations, the measurements are not quite reliable. How is it possible and at what price, to obtain and to measure a tolerance of 30μ for diameters of 500 mm. (new precision grade) when a temperature difference of 3 deg. C. alone produces an error of 18μ, and at 5 deg. difference this error absorbs all the tolerance? Even with a snap gage of ideal rigidity and with temperature errors entirely absent, there would be spots on the shaft on account of errors in geometric shape over which the "go" as well as the "no go" side would pass. The same could be said about the tolerance of 45μ on a bore of 800 millimeters.

The uselessness of $\sqrt[3]{D}$ for the calculation of tolerances for the larger diameters becomes even more manifest when we extend the parabola to 2,000 mm. The tolerance of the shaft in the fine grade for a diameter of 1,000 mm. is equal to 50μ; for a diameter of 2,000 mm. it is equal to 60μ; and the increase in tolerance amounting to 10μ will be entirely swallowed up by the temperature error alone caused by a difference of 1 deg. Centigrade.

To confirm the $\sqrt[3]{D}$ rule, Gärtner states that the Siemens-Schuckert Works uses for larger diameters the fine precision grade, and for small diameters the medium and coarse grade. Unfortunately, the author does not state the reasons for this unusual method, but it seems to us that its root proceeds from the peculiarities of electric-motor and generator production, especially of induction motors in which a minimum gap between rotor and stator plays an important part. Production of parts of large diameter is carried out, as Gärtner acknowledges, to micrometers and not to limit gages. This special case, therefore, cannot serve as basis for criticising general standards.

When we discuss the general rule governing the increase of tolerances with increasing diameters, we must pause over Damm's contribution. In order to confirm $\sqrt[3]{D}$, a diagram of geometric errors is produced. Damm, however, does not state whether his figures refer to bores or shafts. From the context it may be taken that he refers to geometric errors of shafts. In that case he incorrectly compares his errors in shafts with Skoda errors in bores. If we transfer from the Skoda diagram the line denoting Skoda errors of shafts to Damm's diagram, we notice a very close agreement of results. The investigation of geometric errors in bores would produce smaller deviations in Damm's case than the Skoda values, because he considers shorter bores than 1.5 D.

W. Kühn, who some time back has defended $\sqrt[3]{D}$, does not express himself fundamentally against this formula, considering it important for the designer to select for each diameter a proper fit without being bound to a certain grade. The main reason for preserving $\sqrt[3]{D}$ is seen by him in the trouble and expense caused by every change.

Economical production is closely bound up with the numerical values of tolerances, and with the correct employment of a tolerance system. The utmost attention has been paid to this question and also to interchangeability with the D.I.N. system. Designers, especially those lacking experience, endeavor, as is well known, to specify the narrowest tolerances. This tendency, coupled with the fact that only the D.I.N. fine grade contains all kinds of fits, has been largely responsible for its adoption as the principal grade and has contributed to its widespread use. Guaranteed medium force, wringing and tight fits requires precision grade tolerances. A transition to the medium grade in the D.I.N. system is possible only for loose fits, and even then its use requires a great deal of caution due to the two-fold increase in tolerances.

Requirements of economical production, and the possibility of the fullest utilization of different fits, have been the principal reasons for the introduction of all eleven fits into the Skoda medium grade. Orderliness is not lost thereby, neither is flexibility which allows a simpler selection of a suitable fit than a combination of bores and shafts of different grades as recommended by the D.I.N. system. The medium grade is used whenever the question of economical production predominates, and when a selective assembly for medium-force, wringing, and tight fits may be used within the widest limits. If it is absolutely necessary to safeguard the characteristics of a fit, the fine grade is to be used, or, in exceptional cases, the very fine grade.

Conclusions

Prof. Dr. Ing. G. Schlesinger considers the proposed reduction of tolerances of the D.I.N. system in small diameters and increase in large ones to be incorrect. However, actual conditions of production and inspection, as well as some facts disclosed by the representatives of German industry are not in complete agreement with the basis. American and English firms working to limit systems differ from the D.I.N. system considerably in principle as well as in numerical values, and therefore open to the same objections as the Skoda system, are producing first-class goods, serving as models to European makers. Although I recognize Prof. Dr. Ing. Schlesinger's great experience and well-merited worldwide authority, I am unable to see any errors in my solution of the tolerance problem.

All objections against the Skoda system concur that the shortcomings inherent to the D.I.N. system may be rectified within the system itself by organization and education. It is beyond dispute that long experience

with any tolerance system will find ways and means for its perfection and rectification. However, experts in this line and men capable of utilizing a tolerance system in a proper way are very scarce, and therefore the only standards which are of practical use are those with which less experienced workmen and designers may produce a minimum amount of scrap and require a minimum of attention from the management. The Skoda tolerance system was intended to remove or to limit the possibility of producing errors and costly mistakes in the shops.

Details of Jigs and Fixtures—*Discussion*

By E. F. T. Clark
Surrey, England

HAVING enjoyed reading some of the later articles by J. A. Potter on page 565, Vol. 67, of the *American Machinist*, I turned to the back numbers to look at the earlier parts in the series as I had somehow missed reading them. Right in the first of the series I came upon some points which I would like to enlarge upon. In view of the importance of the drill bushing, I think Mr. Potter could very well have afforded a little more space to considering the pros and cons of the two types he dealt with, viz., headless or liner type, and the fixed shoulder type. Opinions are mixed regarding preference for either type, but I personally think that the headed type offers some distinct advantages.

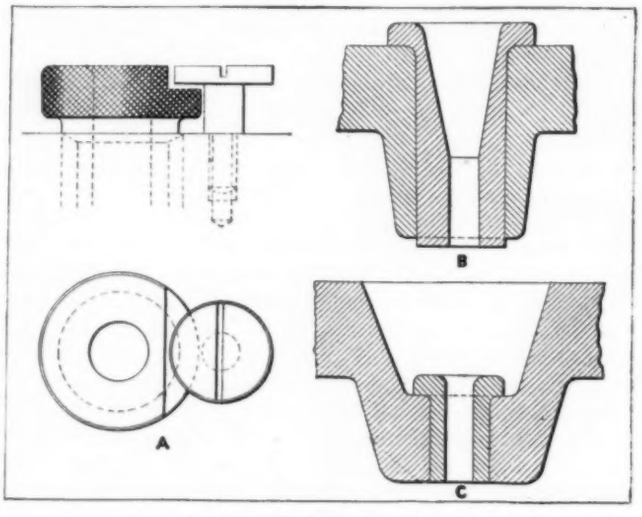
Why I consider that the headed type of bush is preferable, is due principally to its function. A drill bush is intended to provide a hardened surface to the cutting tool and so insure the location of the hole, and yet permit of easy replacement due to wear. If the liner type of bush is employed the area in the immediate vicinity of the hole for the bushing becomes pitted by the drill point, and this is almost bound to affect the accuracy of replacements. With bushes provided with a head the area around the hole is protected, and accuracy is more assured.

Mr. Potter gives, further on, general proportions for bushings, and gives the length as a function of the diameter of the drill. I think this is likely to lead to curious proportions. A good designer will of course correct these almost subconsciously, but a newcomer to the field of jig and tool design is likely to follow anything written in articles of this description very closely. All bushes having a hole diameter of $\frac{1}{4}$ in. to 1 in. I give, as a general rule, a wall thickness of $\frac{1}{8}$ in. Further, no bush should be less than $\frac{3}{8}$ in. outside diameter, unless to fill a special bill. All bushes above 1 in. hole should have a wall thickness of $\frac{3}{16}$ in. The length of the bush should then be not less than $1\frac{1}{4}$ times the outside diameter.

Regarding certain references to slip bushings, Mr. Potter says that slip bushings under $\frac{3}{4}$ in. outside diameter must be provided with a stop in order to prevent rotation in the bushing lining. My experience has been that unless a bushing is provided with a stop it will rotate, no matter what its diameter may be. Also, slip bushes, no matter what their diameter, will back out of the liner bush and turn around unless prevented by a stop. For that reason the examples shown in his Figs. 4, 5, and 6 are unsatisfactory.

Such stops will prevent the bushing turning for a period, but not against backing out. The pressure of the cuttings will force the bush up until its head is clear of the stop pin, and when it arrives at this position it will commence turning with the tool. This will cause partial wear of the liner, and results will be worse than if no stop had been used. Stops should therefore prevent rotation and also movement in an axial direction. The fact that they will prevent the bush falling out when drilling from the opposite side is only a secondary consideration. Being a slip bush they are usually removed, so that they are not there to fall out.

Instead of multiplying types or methods of obtaining the same result, I should have preferred Mr. Potter to consider one design, and, by including as many good points as possible, develop a type which could be standardized. For some years I have, in teaching, and in drawing offices, stressed the importance of standardized



Some typical jig bushings

jig details. For this reason, therefore, the designer can forget all the types illustrated excepting Fig. 8 of Mr. Potter's selection. This design, with a slight modification, I have proved over long experience to be the best all-around type of bushing. At *A* in the illustration is shown the design which I consider good enough for standardization. It is simple and comparatively inexpensive to manufacture. The portion milled right across enables the bush to be used with tools of either right hand or left hand rotation.

Another point on which opinion is sharply divided is the method to employ in relieving the inner surface of extra long bushings. Personally, I consider the bushings shown in Mr. Potter's Figs. 15 and 16 as potential drill breakers. The cuttings coming away from the drill point will work up the flutes and become wedged between the lands of the drill and the surface of the counterbore. This will cause the drill to bind up in the hole and break. Fig. 16 is, if anything, worse in this respect than Fig. 15.

If a jig bushing must have its tool bearing surface reduced, then it should be accomplished as shown at *B*, that is, the mouth should be tapered so that cuttings can have free egress. As long bushings are used only to reach into a more or less inaccessible point, I try to use a standard bushing and recess the casting as shown at *C*. It may cost more, but I believe it pays.

Cylinder Bushing Practice in Leading Railroad Shops

By Fred H. Colvin
Editor, American Machinist

Methods employed in turning and boring cylinder and valve bushings are described, also the operations of putting them in place, and the mandrels and mechanisms used in handling these parts

CYLINDER bushings, or liners, as some shops call them, have become a regular part of locomotive construction since the advent of steel castings in the saddles, or front ends, of modern motive power. Instead of waiting for cylinders to wear before putting in a bushing, the new cylinder has a bushing before it goes into service, because cast iron makes a much better wearing surface than steel. Similar bushings are used in the valve chambers of the piston type of valve that has become almost universal since the advent of higher steam pressures in locomotive boilers. These bushings, on account of their size and their thin walls, present several machining problems to the back shop. It is not a particularly easy job to bore, turn and face a bushing approximately 30 in. in diameter, 40 in. long and only about $\frac{3}{4}$ in. thick when finished. The thickness varies to some extent, as do the other dimensions, but in all cases, the bushing is a thin shell, none too easy to machine accurately. In most cases, an effort is made to get a fairly hard close-grained iron for both cylinder and valve bushings.

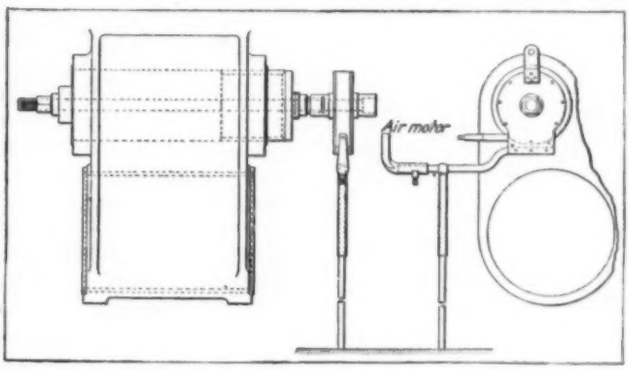


Fig. 1—Pulling-in device in place to pull a valve bushing. It shows how the air motor is held and the floor support, which prevents the device turning

Practice as to boring the bushings varies widely. Both horizontal and vertical boring machines are used, the former with boring heads of various kinds. Some shops rough bore the bushings with the same type of a portable boring bar as is used in reboring cylinders or bushings in place. Where the vertical boring mill is used the outside can be turned at the same time the inside is being bored. The finish turning of the bushing is frequently done on a lathe using a special mandrel, the design varying considerably in different shops.

A simple form of mandrel is shown in Fig. 2, where two, four-lobed heads are mounted on a substantial bar which has suitable centers in each end. Each arm of each head carries a cone-headed adjusting screw with a hardened point. These screws permit easy adjustment for a limited range of sizes and also permit centering the bushing true with the bore. They also hold the bushing against the cut of the turning tool, the thin wall not permitting heavy cuts to be taken.

Another method of holding cylinder bushings is shown in Fig. 3, where end plates are made to fit the bored, or counterbored end of the bushing, and to support it while being turned. These plates are frequently made with steps to take two or three sizes of bushings, which are held by long through bolts that clamp the two plates to the end of the bushing. Four bolts, from $\frac{3}{4}$ to 1 in. in diameter, are generally used. Two sets of holes are provided in the plates shown in Fig. 2. The plates carry a center, and driving lugs, as at *A*. Valve bushings are handled in a similar manner, although one railroad mounts the end plates on a large bar as in Fig. 4. One head is fixed on the bar, which in this case is $3\frac{1}{2}$ in. in diameter and is a press fit. It is assembled in the wheel press. The other head is a sliding fit on the bar. Four $\frac{3}{4}$-in. through bolts, or studs, clamp the bushing between the two heads. Centers are carried in each end of the bar. Practice varies widely in pulling the bushings in both cylinders and valve chambers. A large number, perhaps the majority, pull in the valve bushings and shrink the cylinder bushings in place. Some use a combination method for the larger cylinder bores, expanding the cylinder somewhat to make it easier to pull in the bushing.

One large shop provides for two stepped bearings each 10 in. long. One of these is secured by leaving the cylinder bore $\frac{1}{32}$ in. small for a distance of 10 in. at the back end. The opposite end of the liner is left $\frac{1}{32}$ in. large for the same distance. In this way the small end of the liner can be pushed in easily, until it strikes the reduced part of the cylinder, and its own enlarged part comes against the outside end of the cylinder, after which it is pulled home. This method gives a 10-in. bearing at each end with only a short pull. These bushings are turned and bored at one setting on a vertical boring mill.

There is a variety of pulling devices in use, but they are for the most part similar in design and application. Different applications of the screw and nut, operated by hand or power, are in common use. In most cases the device is designed to be driven by an air motor, usually through worm or other reduction gearing. In some small

pullers for valve bushings, the motor drives the nut on the rod. A typical pulling-in device is shown in Fig. 5, and in detail in Fig. 6. As shown, it is designed for valve bushings, but similar pullers are used on cylinders, the sizes and gear reductions being designed for the pressures required. The bronze worm wheel *A* is mounted on a sleeve *B* and drives it by two ½-in. square keys 3½ in. long. The bearings are on the hub of the worm gear in this design but in some others they are on the sleeve that surrounds the screw itself. The bearing bushings are plain, as at *C*, and are of soft steel. They are held by the side plates *D*, with the flanges inside, and bearing against a shoulder on the worm gear. These side plates are ⅜ in. thick and with the distance piece *E* clamped between them, form a substantial case for the driving mechanism. At the bottom of the case is the worm housing *H*, with bronze bushings for the driving shaft *J*, which drives the worm *K* by two long keys on opposite sides of the shaft. The thrust of the worm is taken by the ball bearing *L*. Below the worm housing is the extension *M* by which the case is prevented from turning, through some sort of a fulcrum, as in Fig. 1. The way in which these parts go together is outlined in Fig. 5, showing the puller in place with the driving sleeve over the nut on the taper shank shaft and the 2-in. threaded rod. A square thread, 4 per inch, is used in this case. Some use an Acme form of thread, 2½ in. in diameter, and 3 thds. per in. The pulling-in screw goes through the sleeve, which is driven by the worm wheel and on which it is mounted.

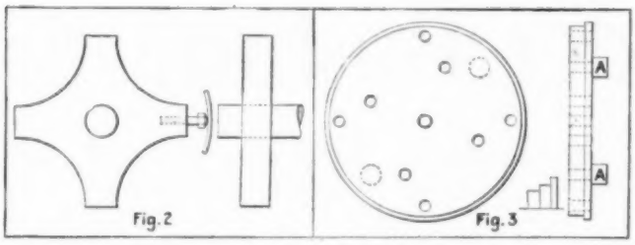


Fig. 2—A simple form of mandrel for turning cylinder or valve bushings. The four-lobed heads are mounted on a shaft, each lobe carrying cap or setscrews with heads having hardened cone points that hold the bushing.

Fig. 3—Chucking plates used to hold cylinder bushings for turning the outside. The ends of the bushing fit over steps in the plates that clamp the bushing between them by through bolts. The plates carry centers on which they turn

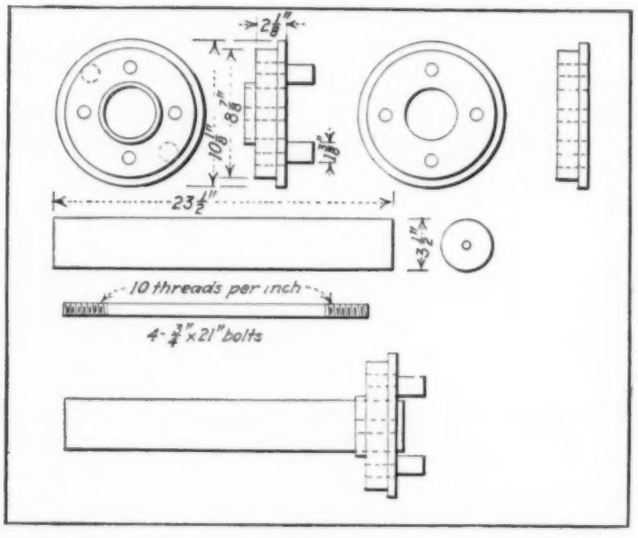


Fig. 4—End plates for valve bushings. One plate is shrunk on the bar and drives it by means of the projecting studs shown

Still another type, one using spur gear reduction, is shown in Fig. 7. The gear train used has 13, 55, 13 and 80 teeth, giving a reduction of about 26 to 1. This driving mechanism differs from the rest in that its sleeve is not threaded. It simply revolves the bar, the nut being held stationary. The thrust on the bar is taken by alternate metal and fiber washers.

A puller of what might be called the direct type is seen in Fig. 8. This is, of course, much more easily made, but it could not be used on heavy work without gear reductions of some kind between the puller and the motor. The nut that does the work is driven by a hollow hexagon socket welded to the end of a yoke, as at *A*. The yoke opening is 15 in. long, allowing that length to be pulled in before resetting the nut. With short bushings at each end of the chamber this is sufficient. A No. 5 Morse taper shank is provided for driving the yoke. The assembly sketch at *B* shows the operations of this puller.

The allowances for the fit of the bushing in the cylinder vary between rather wide limits. On cylinders from 22 to 30 in. in diameter one road allows 0.004, 0.005 and 0.006 in. respectively. Another road gives the allowance as a half-thousandth per inch of diameter, which

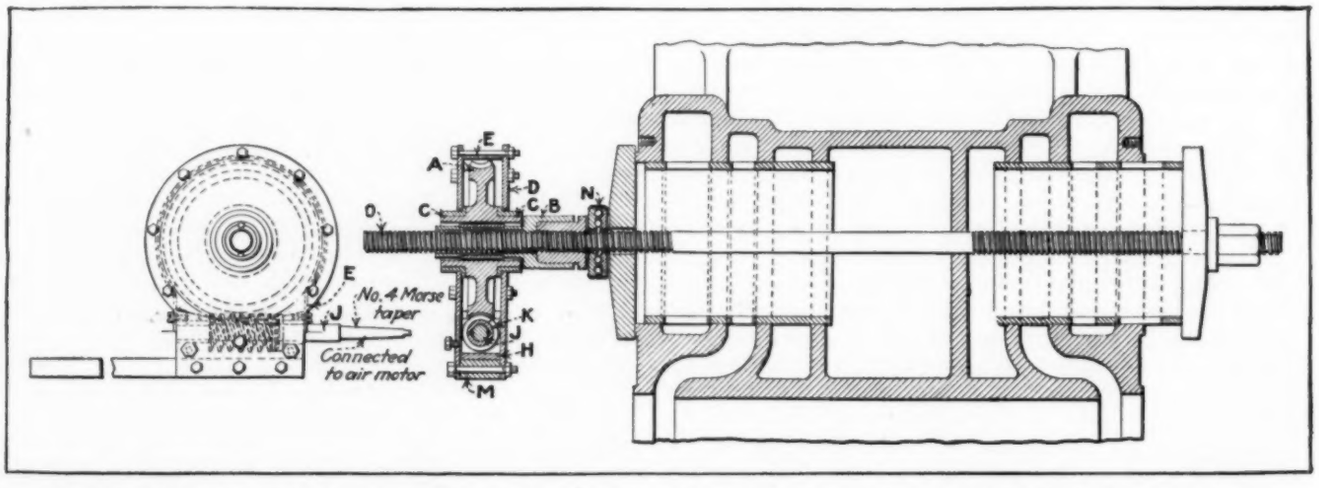


Fig. 5—Pulling-in mechanism assembled and in place on a valve bushing. This shows the application to the screw with the thrust ball bearing in place

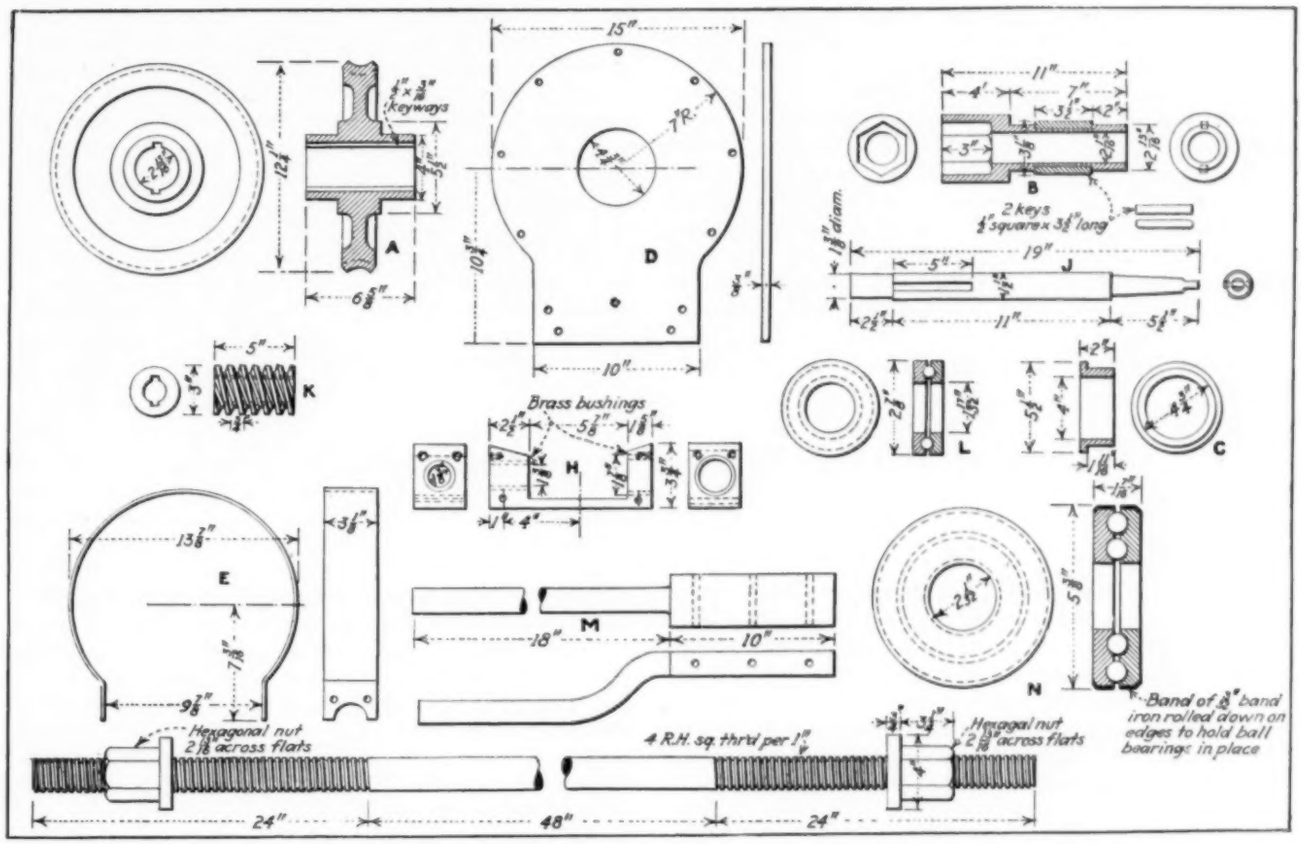


Fig. 6—Details of the pulling device in Fig. 5. This shows how the various parts are made and the principal dimensions

would give 0.015 in. on a 30-in. cylinder, and seems excessive. One road allows 0.003 in. for valve bushings, and it doubles this, or 0.006 in., for cylinder bushings, regardless of size.

Some shops use what they call an "iron to iron" fit, but as this is an old-fashioned shop term for a light force fit, their practice differs little from common practice.

In only one case does the comparatively loose-fit bushing find favor, and opinions as to its desirability differ. Some shops say it will come loose while others contend that it will soon rust tightly in place. If it is not a tight fit it must, of course, be dowelled to prevent movement until it has corroded into position.

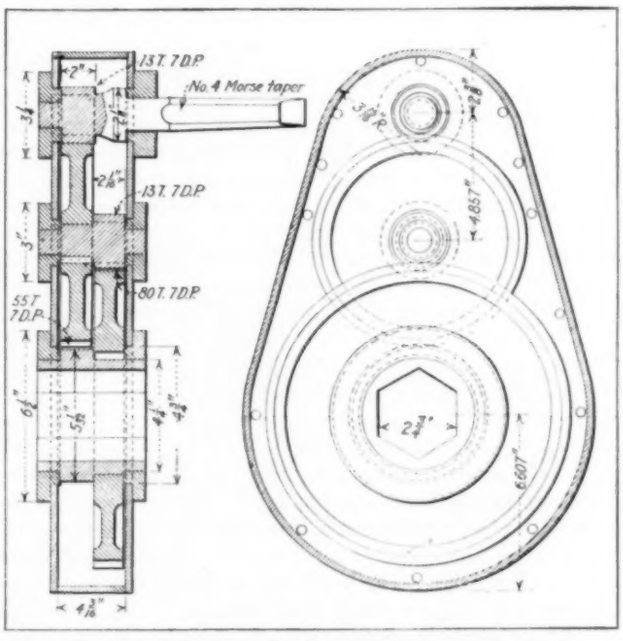


Fig. 7—A spur-gear reduction unit that can be used as a puller-in, and for various other purposes

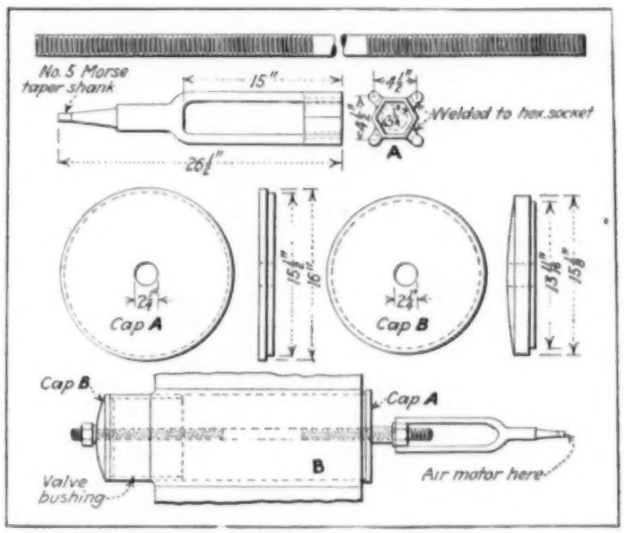


Fig. 8—A lighter pulling-in device for use without reduction gearing in the mechanism itself

Practice also varies with regard to finishing the bore of the bushing to size before inserting it in the cylinder. Some bore to size, while others bore undersize and finish in place, using the ordinary portable boring bar.

Another difference of opinion exists regarding the heating of cylinders for shrinking the bushing in place.

Heating methods vary from that of building a small wood fire in the cylinder bore to using an oil-fired torch such as is used in preheating for Thermit welds. In between these extremes is the use of charcoal fires and of various sorts of torches, sometimes made by utilizing discarded super-heater tubing, drilled with burner holes. In one case, at least, the air jet is introduced in such a manner as to cause the flame to swirl around the inside of the bore and so distribute the heat more or less evenly around the cylinder walls. It is common practice to pull the valve bushings at the same time so as to take advantage of the expansion caused by the heat working its way up into the valve chamber.

Grinding, or honing, of either cylinder or valve bushings is conspicuous by its absence. A few are considering grinding for the valve bushing, but there seems to be no definite tendency toward grinding the cylinder bore, though it is reported that at least one British railway has adopted the practice and finds it good. Grinding seems to be looked upon only as a refinement of finish rather than an economical method of machining metal. Honing is placed in an even higher class in the minds of many. But a study of the cost of producing finely finished bores in automobile and similar engines might show that honing was an economical method of securing accurate bores with a long life finish. It is interesting to note that experiments are under way for finishing locomotive cylinder and valve bushings by this method.

Grinding Methods for Tungsten Carbide Tools

By A. H. Prey

Engineer, The Carborundum Company

THE chief characteristic of tungsten carbide is its extreme hardness. Various Brinell figures show hardnesses from 1,800 to 2,400, compared to a maximum of about 800 for hardened high-speed steel when determined in the same manner (Rockwell no load converted to Brinell figures). The new material will scratch sapphire, and its hardness lies between that of Aloxite (fused alumina) and Carborundum (silicon carbide). An aluminous abrasive wheel is out of the question for use on tungsten carbide and we must go to the harder abrasive, silicon carbide.

Tungsten carbide material for tools is supplied to the trade at the present time in two forms, one a roughly shaped piece to be mounted and ground to its final form by the customer, and the other a finished tool ready for use. From the user's standpoint, there are two grinding problems involved where he mounts his own tool, but only one where he buys the finished tool.

In the first case, the tool must be ground to its final form and finish ground to secure the correct sharp edge. A relatively large amount of stock must be removed. After forming, there remains only the regrinding, which will be described later. A soft wheel, with grades P to V (Carborundum Company grading) and grits 40 to 60 in W bond, is recommended for this work. Shop conditions vary widely, and will have a marked effect upon the selection of the correct grinding wheel.

The regrinding of a tungsten-carbide tool should consist of three operations: (1) Rough grind, (2) Finish grind, (3) Stoning or Honing. The rough grind is to bring the tool to its correct shape, and the finish grind and stoning are to give a smooth finish and a sharp edge. The makers of tungsten carbide emphasize the importance of an edge free from grinding marks. The combination of a finish grind on a fine grit wheel, followed by a hand stoning operation with a small silicon carbide stone will give the required cutting edge. It may be possible to eliminate operation No. 1, where the point of the tool is not badly worn, but where considerable stock is to be removed it should be performed.

For these operations the following gradings are recommended (Carborundum Company grading):

1. Rough grind—60 grit, N to U grades, W bond wheel.
2. Finish grind—100 to 120 grit, S to V grade, W bond wheel.
3. Stoning—Any fine grit, medium grade Carborundum stone, for example, 4x1x½—2F—G6.

In addition to the selection of the right grinding wheels to give a good cutting edge, there are several points in grinding that should be watched. Wheel speeds should be low rather than high. From 4,000 to 5,000 surface-feet per minute is about the correct range. The pressure of the tool against the grinding wheel should be light, otherwise excessive wheel wear will result with no faster cutting action. The user must expect a higher wheel wear than when grinding high-speed steel. Clearances and angles for tools made of tungsten carbide alloys differ from those standard for high-speed steel and the manufacturer's specifications should be followed closely.

A rigid grinding machine is essential, otherwise wheel wear will be excessive. The tool should be on a solid rest. If applied only by hand without a rest, bumping takes place and the wheel, which is very soft, will quickly get out of true. The tool should be approached to the wheel carefully and the heel should come in contact first, otherwise the tool will dress the wheel, or at best, a very ragged and chipped-edged tool will result.

Plenty of Water Should Be Used, If Any

There is some disagreement among the various manufacturers of tungsten carbide relating to the use of water in grinding. It is enough here to say that if water is used the supply should be plentiful, because a little is worse than none. The heat conductivity of this material is low, and there is danger of localized heating and checking. It is probable that different grades of wheels will be necessary for use on materials of different makes, but the variations required will have to be determined by additional test work in the field.

The use of this new tool material is still in the experimental stage, consequently the grinding problems are not yet completely solved. A material having characteristics so radically different from those of high-speed steel, requires time for development to its highest efficiency and grinding wheels must develop along with it. We have dealt only with hand grinding. Machine grinding of this material on any of the several tool grinders is distinctly another problem still in the experimental stage. It is being given close study, however, and the results will be available in the near future.

· BOOK · REVIEWS ·

How to Analyze Costs. By Coleman L. Maze and John G. Glover, assistant professors of management, School of Commerce, Accounts and Finance, New York University. Three hundred eighty-nine 9x6-in. pages. Indexed. Thirty-three figures. Published by the Ronald Press Company, 15 East 26th St., New York, N. Y. Price $5.

BUSINESSES fail principally, say the authors of this book, because the managers do not have a fundamental knowledge of the part that costs play in all phases of the conduct of business. Perhaps they ignore cost data through a lack of understanding or because of impatience with unsuitable reports. Or again, these executives may use elaborate cost systems with poor results, because they expect them to be proper substitutes for intelligence.

Believing that final judgments and decisions must be made by management, and that cost data are intermediate steps in forming them, the authors have written twenty-two chapters presenting a detailed analysis of the major elements of manufacturing, selling, and administrative costs, and setting forth a procedure for determining the causes of their variation from the figures of previous periods or from estimates. It is aimed to give managers a working basis to shape their policies to the everchanging status of their businesses. Furthermore, it will help them to develop better methods of utilizing facts about their businesses as disclosed in the cost records. Many worth while suggestions are also made to cost accountants to aid them in preparing reports that will be understood easily, save time, and give suggestions to the executives concerned.

The ABC of Aviation. By Victor W. Page. One hundred forty-three pages, 5x7¼ in. Paper cover. Published by the Norman W. Henley Publishing Company, New York City. Price $1 in paper cover.

AS THE name implies, this little volume may be called a primer in matters pertaining to aviation. It contains much elementary information regarding both airplanes and lighter-than-air craft. There are many illustrations that give, in a sketchy way, a very good idea of the main characteristics of both planes and engines of different types. It contains brief notes of the history of aviation and will be of interest to those who know little or nothing of aircraft development, which is all that is intended.

Practical Color Simplified. By William J. Miskella. One hundred thirteen pages, 6x9 in. Embossed waterproofed board covers. Color plates and charts. Indexed. Published by the Finishing Research Laboratories, Inc., 1167 West 22nd St., Chicago, Ill. Price $3.50.

IN THE Latin countries color has been used widely from early times, but it is only recently that bright color schemes have attracted the American and northern European eye. Bright colors are not only now being applied to automobiles and the ordinary things of daily life, but they are also being used on tools, implements, typewriters and office machines, and more recently on machine tools. This fact has led to much investigation on the subject of color matching, combinations and harmony, and the proper use of pigments, and the author of this book has attempted to assemble an outline of the basic points into one convenient volume.

Much of the material in the book is already obtainable in the trade literature of the manufacturers of pigments and finishes, but it has the advantage here that it is arranged conveniently and systematically. The color selection and harmonizing charts are original and useful. There are twelve chapters in the book, dealing with such subjects as color choosing, mixing, harmony, matching, color designation, pigments, and color testing.

The World of Machines. By Percy M. Baker. Three hundred twenty-one pages, 6½x8½ in. Cloth board covers. 206 illustrations. Published by Wells Gardner, Dorton & Co., Ltd., 3 Paternoster Bldg., London, E.C. 4, England. Price 7s. 6d. net.

THIS book, originally intended for boys, actually gives a comprehensive elementary exposition of mechanical engineering that ought to be also valuable to the apprentice or to the shop man who has not had the advantages of higher school training.

It begins with a chapter on steel and its importance in engineering, from the production of the iron to the forging and heat-treating of steel tools. Other chapters take up the steam engine, internal combustion engines, water wheels, hydraulic machines, electrical machines, and structural materials and methods. The book is outstanding as an elementary text for the beginner in mechanical engineering.

Mechanical-World Electrical Pocket Book, 1929. Twenty-second year of publication. Three-hundred twenty-six pages, 4x6 in. Published by Emmott & Company, Ltd., 65 King Street, Manchester, England. Cloth board covers. Price 1s. 6d., net.

ADDITIONS to the 1929 volume of the Mechanical World's Electrical Pocket Book are mainly on large electrical equipment. Among these are electrical machinery for coal mines, electric drives for steel mills, and turbo-alternators. Other additions include automatic substations and condenser calculations. As usual, the sections from previous editions are revised in accordance with the most recent practice. The sections on direct and alternating current generators and motors have been given special attention in the revision.

Enamels: Their Manufacture and Application to Iron and Steel Ware. By Lawrence R. Mernagh. Two hundred thirty-four pages, 6½x9 in. Cloth board covers. Indexed. Published by the J. B. Lippincott Company, Philadelphia, Pa. Price $7.

THIS is a book of particular interest to manufacturers of iron and steel articles that are to be given a vitreous enamel. It also includes cast iron, but does not attempt to cover cold processes or decorative work. The book is well arranged, and goes into considerable detail regarding the methods of preparation, pickling, and washing of the metal, as well as describing the characteristics of the materials used for the enamelling.

There are twelve chapters in the book covering the steel blank, properties of enamels, raw materials, preparation of the enamel, cover coats, equipment, and factory layout. Nineteen illustrations and many tables are included. An entire chapter is devoted to the subject of cast-iron enamelling.

IDEAS · FROM · PRACTICAL · MEN

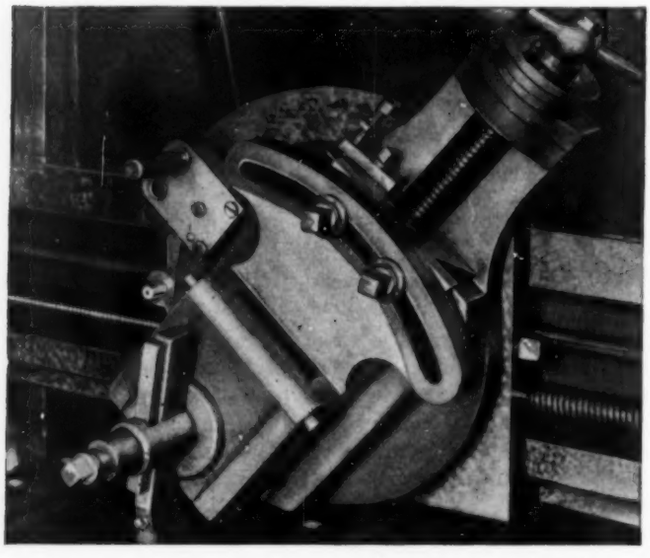
The department, "Ideas from Practical Men," is devoted to the exchange of information on methods useful to the machinery industries. Its scope includes all divisions of the metal-working industry, from drafting room to shipping platform. Descriptions of methods or devices that have proved their value are carefully considered, and those published are paid for. The rates are from a minimum of five dollars upwards, depending upon their merit.

Setting a Planer Head by Chordal Distance

By Matthew Harris

In setting a planer head to an angle, the graduation marks on the swiveling member are good enough for many jobs, but where great accuracy is necessary they fall far short of the requirements. The illustration shows a method by which a planer head can be set for accurate planing to the desired angle.

Attached to the left side of the saddle is a bracket carrying a short, hardened and ground plug. The swiveling member carries a plate having two holes, in



Method of setting a planer head to an accurate angle

each of which is a hardened and ground bushing. The stationary plug and the holes in the bushings are of the same size and are at the same center distance from the pivot of the swiveling member.

The location of the plug and the bushings is such that when a plug inserted in either of the bushings is brought into contact with the stationary plug, by swiveling the head, the slide of the head is a known number of degrees out of the vertical. To set the slide truly vertical, it is necessary only to insert between the plugs a gage block, the size of which is equal to the chord of the known number of degrees multiplied by the center distance of the plugs from the pivot of the swiveling member.

Bearing in mind that the chord of any angle is twice the size of half that angle, it is an easy matter to calculate the size of gage block necessary to set the head to any angle required. Angles either side of the vertical are obtained by inserting the plug in one or the other of the bushings. In selecting a gage block to be interposed between the plugs to set the head to any required angle, it is, of course, necessary to add to the angle required, the angle that the slide is out of the vertical when the plugs are in contact.

An Automatic Bell-Crank Clamp

By C. W. Hinman

A longitudinal section through a drill jig is shown in Fig. 1. The work to be drilled is represented by the dotted cross-section. The drawbolt is pinned to the bell-crank clamp in such a manner that when the wing nut is tightened to bind the leaf and the work, the bell crank automatically forces the work against the stop pin. This action eliminates the necessity for a separate screw for

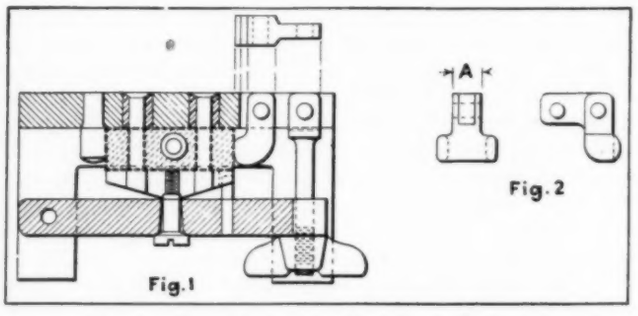


Fig. 1—Jig with automatic bell-crank clamp
Fig. 2—Bell-crank clamp for irregular surfaces

pushing the work against the stop pin and makes the jig rapid in operation. When the wing nut is loosened and the jig leaf is thrown back, the bell crank loosens its grip and allows plenty of clearance for removal of the work.

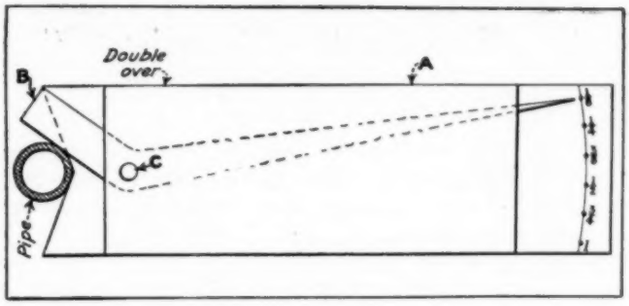
A clamp of the same style, except that it is equalizing, is shown in Fig. 2. The arm *A* is made a loose fit in the jig body, so that it will accomodate itself to work having a slightly irregular surface.

A Pipe-Size Indicator

By H. Moore

Few men can gage the size of a pipe with the eye alone, and it is more difficult still when a pipe is installed. Having to check up the sizes of a large number of pipes from $\frac{1}{8}$ to 1 in., I made a simple indicator that would show me instantly any size within its limits.

The indicator is made from two pieces of sheet metal. One is the case *A* doubled over at one side to enclose the pointer *B*, and both parts are held together by a pin *C*, which also serves as a bearing for the pointer. By making the case as shown the pointer cannot swing any



Pipe-size indicator

further than the sides of the case, so that no spring is needed to keep it in place. To find the size of any pipe within the capacity of the gage it is simply placed on the pipe as shown, and the pointer swings over to the correct figure.

Jack for Use on Locomotive Spring Rigging

By J. H. Hahn

The illustration shows a small jack that is very convenient for use in connecting and disconnecting the spring rigging on locomotives. It can also be used for blocking the spring rigging when dropping the driving wheels. By using several of the jacks, the handling of much blocking will be eliminated.

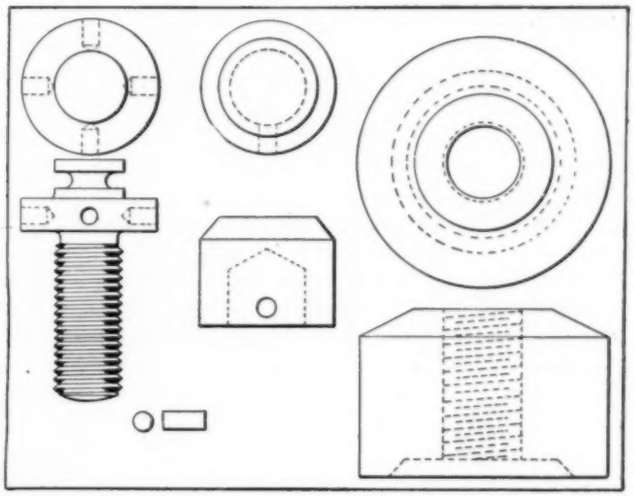


Fig. 1—Details of the jack

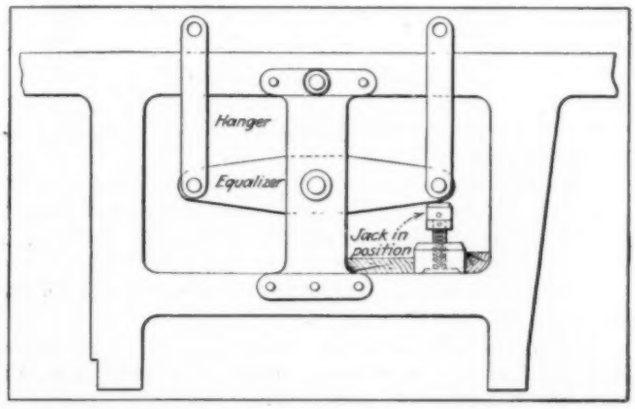


Fig. 2—Jack in position under the equalizer

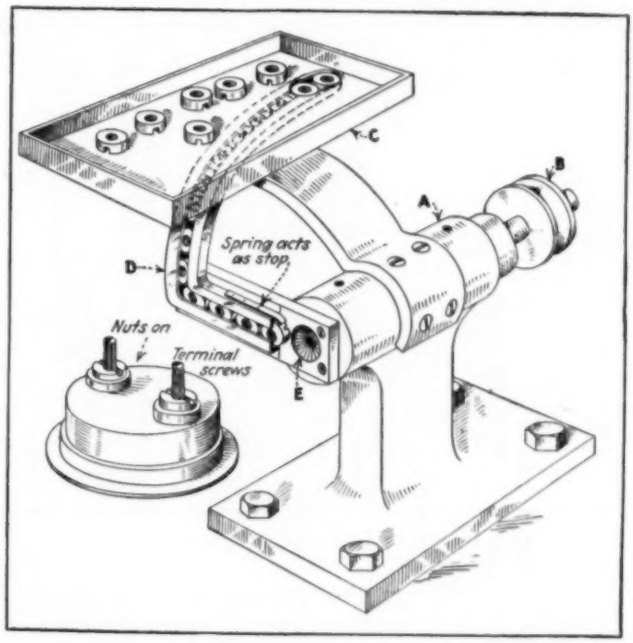
Jacks of this type can be made in sizes to suit different classes of locomotives, and are very inexpensive. Details of the jack are given in Fig. 1, while in Fig. 2, the jack is shown in position under one end of the equalizer.

Assembly Fixture for Studs and Nuts

By Chas H. Willey

A fixture whereby the assembly of nuts to the terminal studs of the Ford dash ammeter was increased 30 per cent over the method previously used, is shown in the illustration.

The fixture *A* has a spindle *B* run by a round belt; the nose of this spindle is a hollow cone *E*, with teeth



Assembling nuts to studs mechanically

cut radially to drive the nut. The spindle is also bored to accommodate the terminal stud.

A pan or hopper *C* is provided to hold the nuts, which are round and have a wrench slot across one face. A quantity of nuts is dumped into the pan and a girl puts them, smooth side up, into the chute *D*. The spring *F* acts as a stop.

To assemble, the terminal stud is just barely entered into the nut and both are then moved along until the nut is central with the conical driver. The drive is not positive and the speed of the head, or sharpness of the teeth is not sufficient to mar the face of the nut or strip a thread, consequently there is no difficulty in moving the stud and nut to a central position. A final tightening is given each nut with a hand wrench.

Expansible Threads—*Discussion*

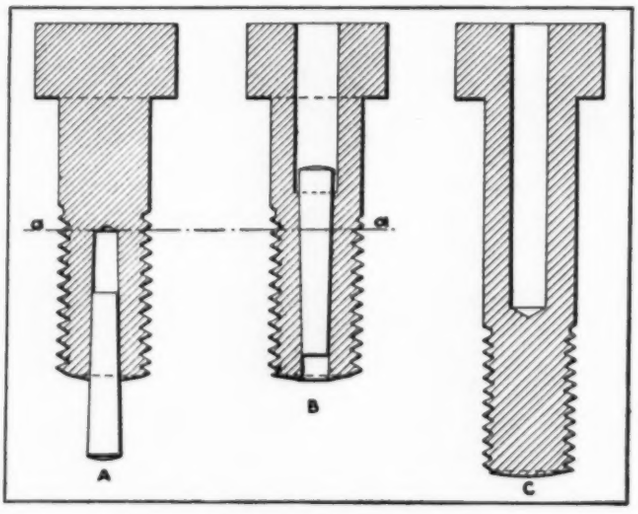
By Henry Simon

Jena, Germany

In an article on page 549, Vol. 69, of the *American Machinist*, R. G. Hewitt, while approving of my method of varying the diameter of screw threads by means of taper pins, feels that the manner of applying them should be improved. He thinks that the screw has to be repeatedly tested until the required fit is obtained,

and proposes some alternate constructions. He reduces the length of the taper pin and hole and proposes to make the screw self-locking by having the head of the pin strike the bottom of the hole.

"The advantages of this method," states Mr. Hewitt, "are that the expansion comes where it is most required, the strength of the screw is not materially weakened as the tapered hole is only one-third of the length of the screw." The relation between a tapped hole, an external thread to fit it, and an expanding action by means of a taper of ¼ in. per ft. becomes a delicate proposition when an exact predetermined movement of the pin is added as a fourth factor. It seems that no slower way could be found to obtain the required fit, quite apart from the fact that the progressive locking action as the



Different methods of expanding threads

screw approached its final position would be about as undesirable from every point of view as could be imagined. With the plan proposed by me, the screw is locked after it is in place, and the question of obtaining the locking action is a matter of a few taps with a hammer, requiring, possibly, ten or fifteen seconds.

After having obtained a locking action at the expenditure of a large amount of work, Mr. Hewitt's troubles would begin when it became necessary to remove the locked screw. As will be seen from my article, I provide a knockout hole back of the pin when I use it for locking. This is just the opposite of Mr. Hewitt's procedure, which gives no possible chance of moving the pin and releasing the expansion. It would be necessary to force out the locked screw all the way.

The screw is not only weakened more than if the hole were drilled all the way through, but, in some cases, as for instance where the screw is subject to repeated shock, considerably more. As a matter of fact, screws are sometimes drilled as shown at *C* in order to equalize their strength. Generally speaking, drilling only the threaded end would be the reverse of good practice, because while weakening the screw at the point of least area and greatest material weakness, it would concentrate on that area the larger part of the stress, instead of permitting the hollow stem above to absorb part of it. In the instance illustrated, the metal removed at the point of least thickness at *B* is at the most 10 per cent more than at *A*. As the core metal is always inferior and as the stem of *A* is solid, the strength of the two screws *A* and *B* is practically the same.

Preventing Cracks in Deep Drawn Sheet Metal—*Discussion*

By E. Andrews

Birmingham, England

I have had trouble with deep-drawn work cracking, like that mentioned by Henry C. Franklin, on page 367, Vol. 69, of the *American Machinist*, and believe our troubles to be similar.

Cracking is due primarily to internal or external stresses. It is obvious that the squeezing of a sheet of metal while being formed must make some difference in its molecular structure. This is particularly true in deep drawing where the thickness is also changed.

Leaving out of the discussion the elements of poor material and die design, the margin by which materials fail is usually so small, as shown by the proportion that crack, that very little is required to prevent that failure. Sometimes, the remedy is simply a time factor sufficient to allow a rearrangement of the molecules, as in the case mentioned by Mr. Franklin.

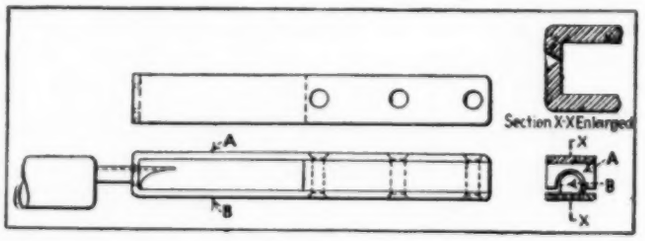
Often, the immersion of the material in hot oil, or boiling water, is sufficient to remove the stresses. A hardened die is often drawn this way. In addition, it is possible to partly anneal any metal to a degree that will provide the required ductility, and not soften it perceptibly.

While there are various methods of testing the "drawability" of sheet metal, they do not tell us whether the corners or bends will "stand up." Generally speaking, sheets with perfectly smooth surfaces draw with the least cracking.

Tool for Cleaning Free-Hand Drawing Pens

By J. E. Fenno

All draftsmen know that it is next to impossible to do good free-hand work unless the pen is cleaned frequently. The ink dries on both sides of the pen and obstructs the free flow of fresh ink put through it. The usual method of cleaning the pen is to scrape it with a knife. This not only gives unsatisfactory results, but



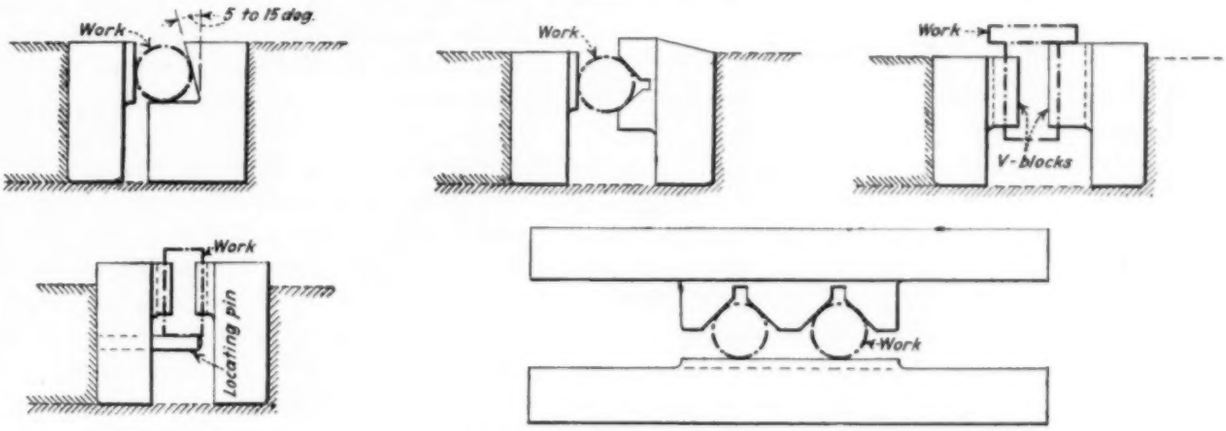
Tool for cleaning pens

may spring the delicate points of the pen, spoiling it for good work.

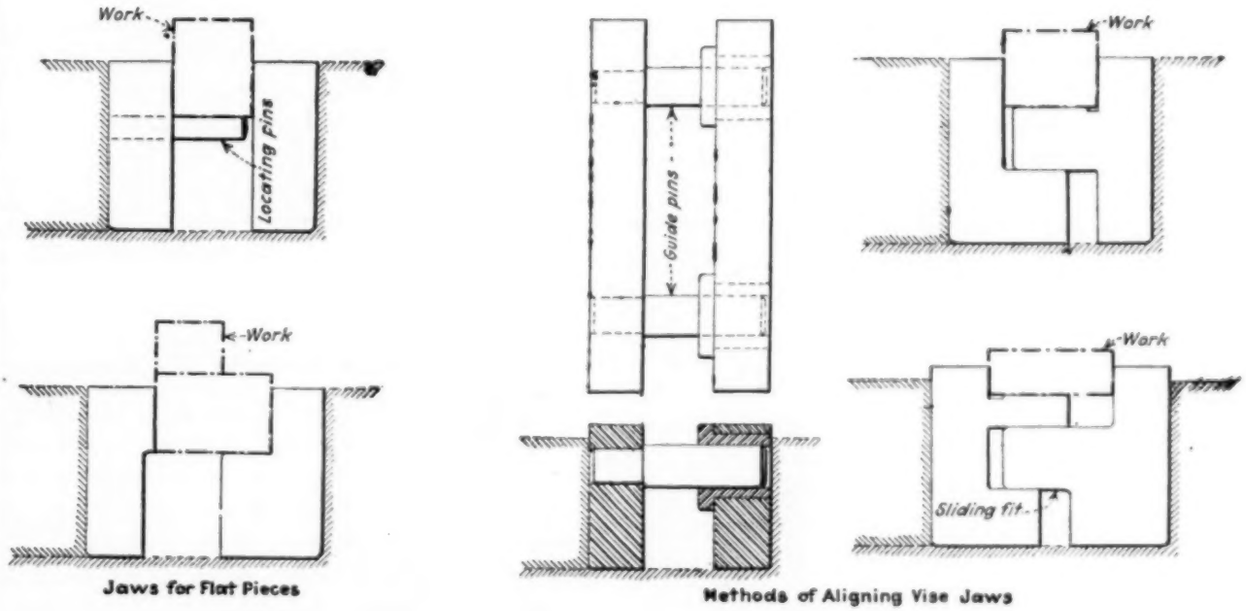
The illustration shows a tool I made for cleaning pens. The ends of the spring fingers *A* and *B* are bent, shaped to the contour of the pen and then hardened. In use, the pen is entered between the fingers and the spring fingers are pressed together. Withdrawing the pen scrapes off the dried ink, leaving it clean.

The filling piece and the spring fingers are held together by rivets, as shown. While the tool, as made, can be used only on pens having the same curvature, most draftsmen use a standard pen for free-hand work.

Typical Vise Jaws and Vise Fixtures

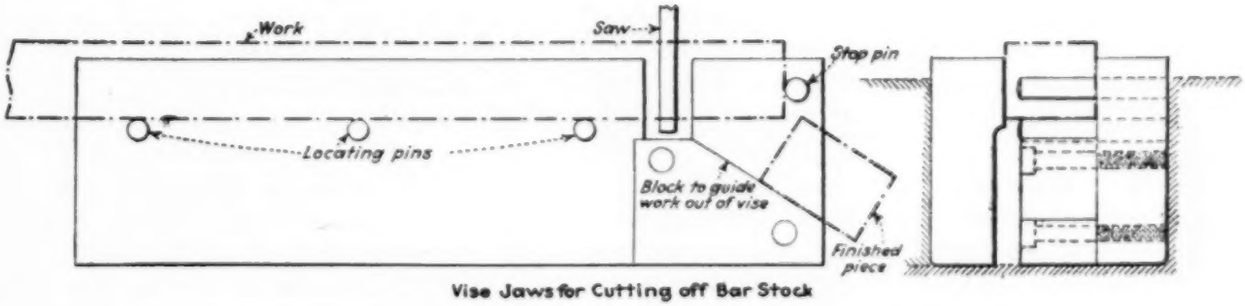


Jaws for Cylindrical Pieces



Jaws for Flat Pieces

Methods of Aligning Vise Jaws



Vise Jaws for Cutting off Bar Stock

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American Machinist

Editors: KENNETH H. CONDIT AND FRED H. COLVIN

Established 1877

Value Does Not Depend on Price

PRECONCEIVED ideas as to prices frequently warp our judgment as to the real value of new tools and appliances. Five hundred dollars a pound for cutting tools is a staggering price at first sight, because we unconsciously think of the price of even the best steel. We would consider it a bargain price for diamond tools, but because we think of the new tungsten-carbide alloys as steel, the price seems prohibitive. In fact, practical, hard-headed production men are quoted as saying that no cutting steel is good enough to be worth five hundred dollars a pound.

As with any commodity, the economic value depends not on what it costs, but on what it can produce. If a machine or tool can produce enough to pay a satisfactory dividend on its cost, it matters little what the cost may have been, unless, of course, the initial investment is beyond the resources of the average user. We are learning that the price per pound is apt to be a misleading yardstick in measuring real values. The fact that some of the largest manufacturers of highly competitive products find it economical to use the new cutting materials proves that the cost per pound has little bearing on the real value.

If the new cutting alloys help managers to realize that initial cost has little to do with real economy, they will serve us well in a dual capacity. They may not only provide economical cutting tools but also dispel false notions of economy in selecting machines and other materials.

Does Standardization Prevent Change?

IN A recent lecture before the British Institution of Production Engineers, L. H. Pomeroy, well known in this country for his advanced ideas in automotive design and construction, warned his hearers against adopting our industrial methods. He urged them, if quoted correctly, to avoid stringent standardization and urged constant change in order to prevent over-production.

Standardization is probably more advanced in the automotive field than any other at present. But we are inclined to believe that production men in the various plants find no tendency to monotony because of lack of changes. In fact we know of no industry in which changes are more frequent, in spite of the standardization work that has been carried on so successfully.

There seems to be a misapprehension as to what standardization really is. Too many are obsessed with the idea that it prevents individuality and insists on uniformity in all things. Here again the automobiles on the market refute the charge of duplication either in appearance or performance.

We doubt if even the extreme individualist would advocate a return to the days when each maker used a different sized bolt, perhaps with an odd thread, to insure all repair parts coming from his plant. Nor is it reasonable to suppose that such parts will be of better design or of higher quality because of being different. In fact, the exact opposite is true. The fallacy that a machine built in small quantities and of special design is either more accurate or of higher quality, in any way, has been exploded too many times to need further attention.

Standardization so reduces the manufacturing cost of high grade articles that it opens ever widening markets for them. In the case of automobiles, at least, it has not as yet caused serious overproduction in more instances than can be cited for products in which standardization is almost unknown.

Those who oppose standardization fail to study the various phases of the subject and do not realize how standards aid rather than hinder real progress.

Forward Looking Management

WITH the first of the ten Ford tri-motored planes delivered to the Transcontinental Air Transport for use in connection with the Pennsylvania and Santa Fe railroad systems, the regular use of planes in coast to coast service may be said to be in sight. The planes are to supplement the railroads by taking such passengers as desire to save time from Columbus, Ohio, to Dodge City, Kansas, and again from Las Vegas to Los Angeles or San Francisco, by plane. In the beginning air travel will be confined to daylight, using the railroads at night.

The significant feature of the development is that the railroads, instead of opposing the new method, are adopting it as an adjunct to their regular transportation business. The railroad officials are to be congratulated on the foresight with which they have met the situation and turned threatened competition into a co-operative agency.

Rockford Redesigned 12-, 14-, and 16-Inch Quick-Change, Geared-Head "Economy" Lathes

INTENDED to meet the demand for a small heavy-duty lathe of sufficient weight and power to handle rapid production, the "Economy" lathe has been redesigned in the 12-, 14-, and 16-in. sizes by the Rockford Machine Tool Company, Rockford, Ill. A front view of the machine is given in Fig. 1, while the left end is shown in Fig. 2. Attention has been given to simplicity of construction and convenience of operation, combined with accuracy essential for tool-room purposes. The swing over the carriage is 6⅝, 8 and 11 in., and the distance between centers is 27, 37, and 51 in., respectively, for the three sizes. The quick-change gearbox gives 32 changes of threads and feeds obtained through sliding gears and hardened steel clutches, and controlled by two large, convenient handles in connection with a tumbler. Standard threads from 4 to 56 per in. and feeds from 18 to 252 per in. can be obtained without the removal of any gear. Special pitches can be cut, however, by substituting extra gears on the quadrant.

As will be noted in Fig. 1, the bed is of extra-heavy design to eliminate vibration on heavy-duty work. The geared headstock is driven by a single clutch pulley and provides twelve forward spindle speeds in geometrical progression, ranging from 15 to 400 r.p.m. The headstocks of the 12- and 14-in. sizes are equipped with Timken roller bearings on all driving shafts, and the spindles run in bronze bearings and also ball thrust bearings equipped with means for adjustment. The 16-in. headstock is Timken equipped throughout, including the spindle. A brake is provided for stopping the spindle instantly. The clutch and the brake on all sizes may be controlled by means of a lever placed on the headstock, while for the 16-in. size, only, apron control of the clutch and the brake is an addition to the standard equipment.

The tailstock is of the offset type, allowing the compound rest to be set parallel with the bed, and is provided with a set-over for turning tapers. The carriage has an extra-wide bridge, which permits heavy cuts without chatter. By means of a thread-cutting indicator provided, the operator may catch any pitch of thread without reversing the lathe. This attachment may be disengaged when not in use. The apron is of heavy design and has double bearings for all shafts. All feeds are reversed in the apron and interlocked in the bronze leadscrew nuts, making it impossible to engage the leadscrew and the feed shaft at the same time.

Power is applied to the headstock by means of a motor mounted within the cabinet base and driving through the headstock pulley by means of a belt. The motor may be either of the d.c. or a.c. type, with a maximum constant speed of 1,200 r.p.m. It is mounted on an adjustable bracket in the cabinet leg, which provides for correct belt tension. When the motor-in-base is not required, the cabinet leg and a countershaft are furnished. Power required ranges from 1 to 1½ hp. for the smallest size to 2 or 3 hp. for the largest size.

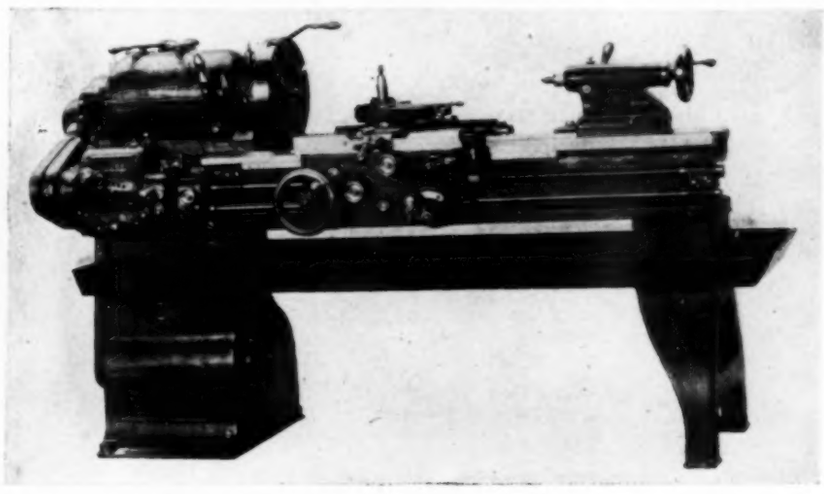


Fig. 1—Rockford 14-Inch, Quick-Change, Geared-Head "Economy" Lathe

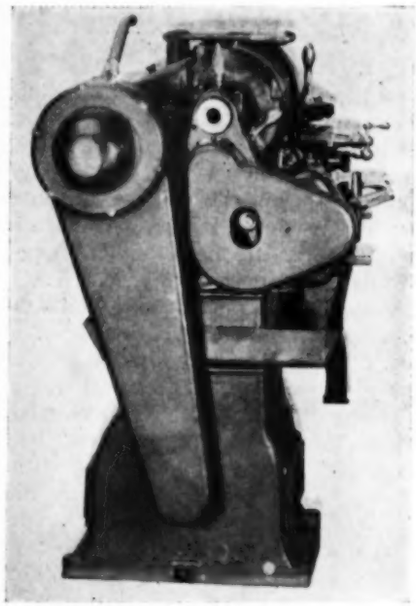


Fig. 2—View of the inclosed belt drive from the motor in the cabinet base to the headstock pulley

Regular equipment includes a steady and a solid rest, large and small faceplates, and wrenches. Among the extras are a draw-in attachment and collets, taper attachment, turret on carriage, turret on shears, and an oil pan.

Oxweld No 21 High-Strength Bronze Welding Rod

An improved bronze welding rod, designated as Oxweld No. 21, has been placed on the market by the Oxweld Acetylene Company, 30 East 42nd St., New York City, N. Y. This rod is recommended by the manufacturer for all bronze welding applications, including the fusion welding of brass and bronze, bronze-welding

of malleable and gray-iron castings, joining dissimilar metals and building up bearings and other wearing surfaces. Due to its composition it has a uniformly low melting point and easily controlled flow. It produces a weld metal as hard and wear resistant as that formerly made with manganese-bronze rod, according to the manufacturer. By its use, tough and ductile weld metal having a tensile strength of over 45,000 lb. per sq.in. can be produced. In addition, it will bond with ferrous metals.

Properties of this rod eliminate almost all boiling and fuming of the weld metal, it is claimed. Annoying fumes are reduced to a minimum and elimination of oxide and gas inclusions is a reason for both the sound and strong weld metal produced and the better adhesion to iron and steel.

Norton Radial Engine Cam Grinder

BECAUSE cams for radial airplane engines are generally much larger than automobile cams, and have contours with re-entrant curves adjacent to the several lobes or high points, a machine capable of grinding such cams up to 10 in. in diam. and with 1½-in. lifts has been developed by the Norton Company, Worcester, Mass. In contrast to the automotive cam grinder using wheels 18 in. in diam., the machine illustrated employs wheels from 1⅜ to 2½ in. in diam. and running at 3,700 to 6,700 r.p.m. for the respective sizes. The machine consists of the base and the tables of the standard Type A 10x 24-in. plain cylindrical grinder, a special wheelslide carrying a small high-speed spindle driven by belt from a motor mounted on the slide, and a standard attachment for the grinding of loose cams or cams not integral with the shafts. A front view of the machine is shown in Fig. 1, the unit being equipped with a motor-driven grinding wheel spindle and a cam-grinding attachment. A rear view of the same machine, Fig. 2, shows the three motors employed for driving the pump, the wheel spindle, and the headstock.

Loose cams, such as are shown in the grinding position in Fig. 3, are usually made integrally in pairs, separated by a narrow space and not attached to a shaft when ready for grinding. A pair, therefore, is mounted in a special headstock having an extra speed reduction in order to obtain the very slow speeds required so that the grinding wheel will have time to cut while the cam roller is following the contour. These headstock speeds range from 5 to 15 r.p.m., ordinarily, but slower speeds have been found necessary in some instances. The headstock is driven by a ½-hp. adjustable speed motor having a speed range of 600 to 1,800 r.p.m. Since the controller supplied has about ten steps ordinarily, it will be evident that an equal number of

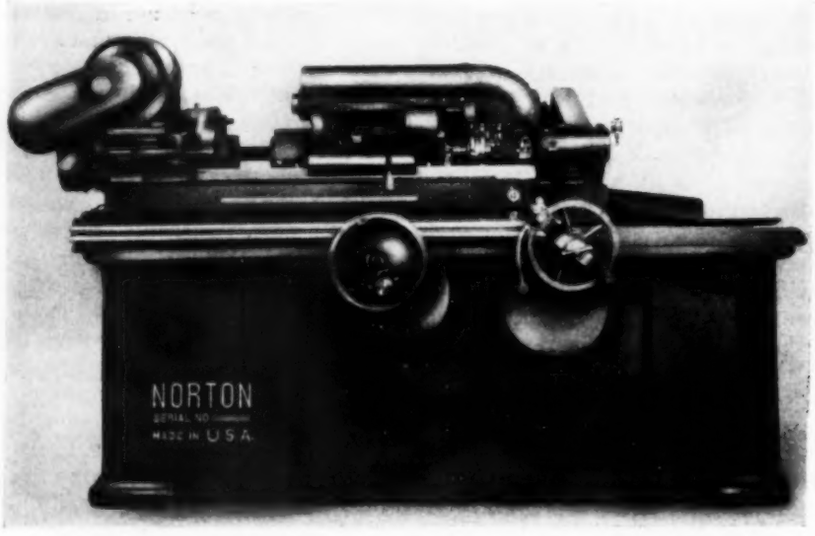
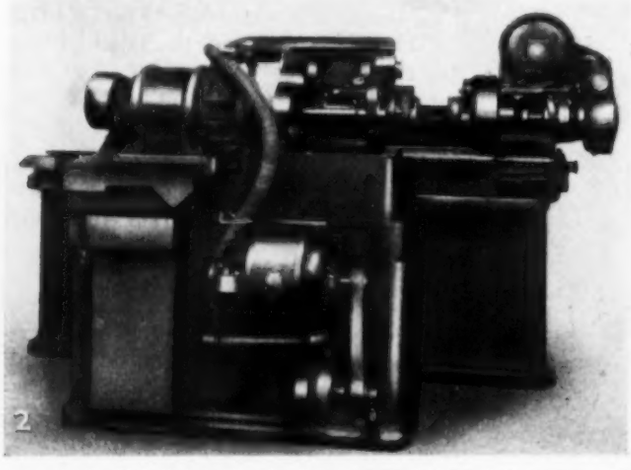


Fig. 1—Norton Radial Airplane Engine Cam Grinder equipped with a motor-driven wheel spindle and a cam-grinding attachment



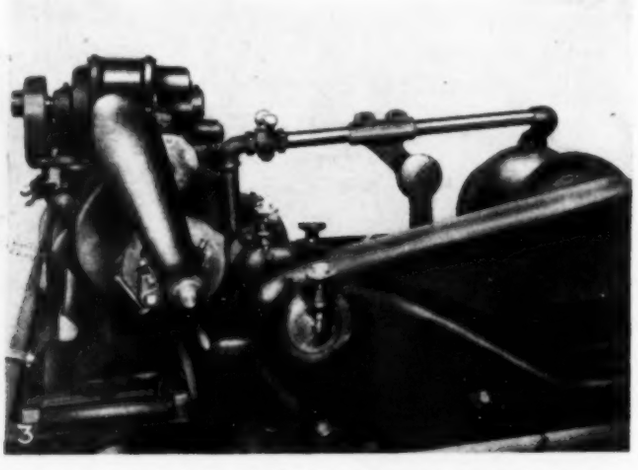


Fig. 2—Rear view of the Norton Radial Engine Cam Grinder showing the motors for driving the spindle, headstock, and pump. Fig. 3—End view showing the small grinding wheel in contact with a lobe on the farther one of a pair of test cams

work speeds may be obtained within the above range.

Either one or two master cams are mounted on the master cam sleeve, according to whether one or two cams constitute the product to be ground. When two cams are ground successively, a convenient lever moves the master cam roller from one master cam to the other, when the table is moved to grind the second cam. A lever is also furnished to swing the cam away from in front of the grinding wheel while making changes in the position of the master cam roller.

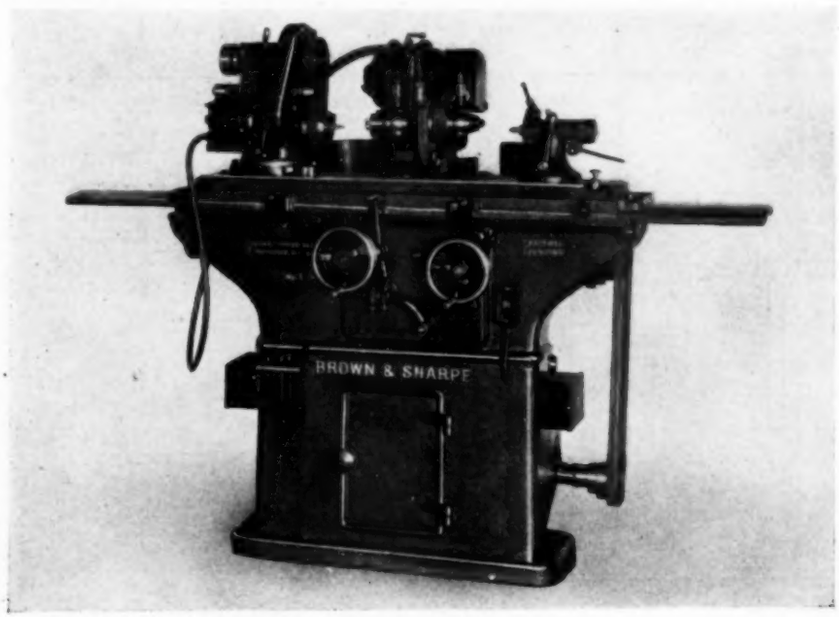
Wheel feed is obtained through the standard feed mechanism used on all Norton cylindrical grinding machines. The amount of coolant pumped to the wheel may vary up to 20 gals. per min., the capacity of the pump. The floor space required by the cam grinder is approximately 6x5 ft. Its net weight is 6,200 pounds.

Brown & Sharpe No. 1 Motor-Driven Universal Grinding Machine

AN ADDITION to the line of universal grinding machines manufactured by the Brown & Sharpe Manufacturing Company, Providence, R. I., is the No. 1 machine placed on the market recently. The machine is similar in design to the belt-driven No. 1 machine, except that, like the Nos. 2, 3 and 4 motor-driven machines, it is equipped with three constant-speed, balanced, electric motors. One of the important features of this machine is the reversible wheelstand motor, which is reversed when the machine is used for internal grinding with the internal grinding attachment. Hence it is not necessary to swivel the wheelstand platen to the reverse position. The motor may be reversed by a lever.

The base is cast in one piece, and is supported at three points. The bed is made long in order to support the table at its extreme travel. The cross-feed slide is counterweighted to eliminate backlash and the pull may be reversed for internal grinding.

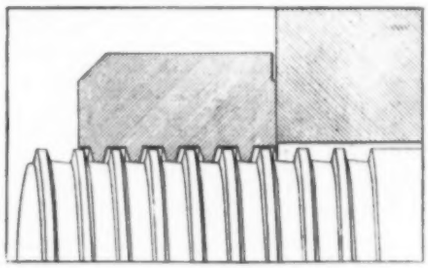
The motors are mounted integrally on the headstock, on the wheelstand, and at the rear of the machine, and are carefully balanced during assembly. The machine may be had fitted with motors only.



Brown & Sharpe No. 1 Motor-Driven Universal Grinding Machine

Dardelet "Threadlock" Bolt and Nut

A new form of screw-thread enables the Dardelet Threadlock Corporation, 120 Broadway, New York, N. Y., to secure a locking action between the bolt and nut that eliminates the use of locknuts, lock washers and cotter pins. The form of thread is illustrated herewith by the section of bolt and nut, showing the profile and the way in which the locking action is secured. The thread angle approximates that of the Acme with the difference that the space is considerably wider than the thread and that the bottom of the thread is at an angle with its axis, the high side, or large diameter, being toward the end of the bolt. The relation between the angles of the bolt and nut is clearly shown. When the nut is screwed on the bolt the action is as follows:



The Dardelet "Threadlock" form of thread

The nut advances along the bolt with the conical surfaces lightly in contact at the small diameter of the angle bteween the threads. When the nut seats on the work the conical surfaces are forced into closer contact and the material of the nut is stressed within its elastic limit until the side, or abutment, faces of the threads are in contact. The nut is then under stress and is locked to the bolt by the friction of the inclined surfaces. The locking action so produced is effective at any point along the threaded length of the bolt. The nut can, however, be readily released with a wrench and can be used repeatedly. It is claimed that the effort required to bring a given pressure on the work is less than required to secure the same pressure with a standard, 60-deg. thread, due to the fact that the friction of the two surfaces in the Dardelet thread is less than with the standard form.

Canton Improved Alligator Shears

Cut steel gears and pinions have been incorporated in the all-steel "Canton" alligator shears manufactured by the Canton Foundry & Ma-

chine Company, Canton, Ohio. The addition of cut gears to this line makes the units very quiet in operation and reduces wear on the bearings and on the shears. Another feature is that the shears are furnished with a gunmetal adjustable bearing between the arm and the bed. This bearing takes up all the wear between the arm and the housing, and it is thus easy to preserve proper alignment. The shears are available in sizes to cut from 2x2-in. rounds or squares, in soft steel or iron to $4\frac{1}{2}$x$4\frac{1}{2}$-in. sections in the same materials.

Leeds & Northrup Automatic Control for Acid Baths

AUTOMATIC control of dilute acid baths to within 0.1 per cent of the desired concentration is afforded by the single-point conductivity recorder controller manufactured by the Leeds & Northrup Company, 4901 Stenton Ave., Philadelphia, Pa. The mechanism by which the control is operated keeps a strip chart, illustrated in Fig. 1, moving forward at a constant rate of speed, and it moves a pen back and forth on the chart as the concentration of acid in the bath varies. Thus, the instrument writes a continuous history of its performance, and the curve is free from such error as would occur if an operator failed to record correctly the result of a periodic test made during manual control. Moreover, the curve shows the conditions existing throughout the whole process.

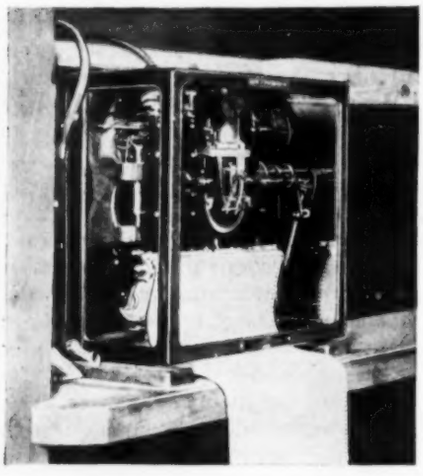


Fig. 1—View of a Leeds & Northrup Single-Point Conductivity Recorder Controller in operation

The automatic control is based on the fact that the bath solution will conduct electricity, and that the electrical conductivity of the solution varies with the concentration of acid. Therefore, a conductivity cell in the bath is made to form a part of the electrical circuit in an instrument that is sensitive to changes in conductivity, and responds in one direction to an increase and in the opposite direction to a decrease in concentration of acid. In responding to such changes, the instrument puts in operation a valve mechanism that regulates the flow of acid to the bath, until the conductivity is equal to that of a solution with the required concentration of acid. Thus, the acid strength is maintained by controlling the conductivity of the bath.

The schematic diagram in Fig. 2 shows the operation of the system. For convenience, two similar conductivity cells are used, one a reference cell *R*, which is closed, and the other a measuring cell *M*, which is open to the bath liquid. Both liquids are thus kept at the same temperature, and the effect of temperature on the conductivity of the liquids will be the same in both cells. By connecting the electrodes in each cell to the binding posts *RC* and *MC* on the control mechanism, the two cells comprise opposing elements of a conductivity measuring circuit, or Wheatstone bridge. The other elements of this circuit are the resistances *A* and *B*, and a slide wire *X-Z* connected between them. A galvanometer *Ga* is connected on one side to a fixed point between the two cells, and on the other to a contact *Y*, which moves on the slide wire. A current from the wires *D* and *E* flows in the bridge circuit.

When the acid falls below the required strength, the conductivity in the cell *M* becomes less than that in the reference cell *R*, and the bridge is electrically unbalanced. This causes the galvanometer to swing in such a direction that the contact *Y*, actuated by a mechanism directed by the galvanometer, moves toward *X* on the slide wire. Another contact *C* moves at the same time and in the same direction, and at a certain position of *Y* it will come in contact with *L*. This closes a circuit in a relay and causes a motor-operated valve *V* to open and admit a flow of acid into the bath. As the increasing acid strength raises the conductivity in *M*, the contact *Y* moves on the slide wire toward *Z*. When this brings *C* into contact with *H*, the connections in the relay change so as to close the acid valve. The contacts *L* and *H*, which actuate the relay, can be set to operate in any desired position of *Y* on the slide wire. As the contact *Y* moves on the slide wire, the pen *P* moves across the chart and draws a curve showing the extent to which the acid strength has varied during the

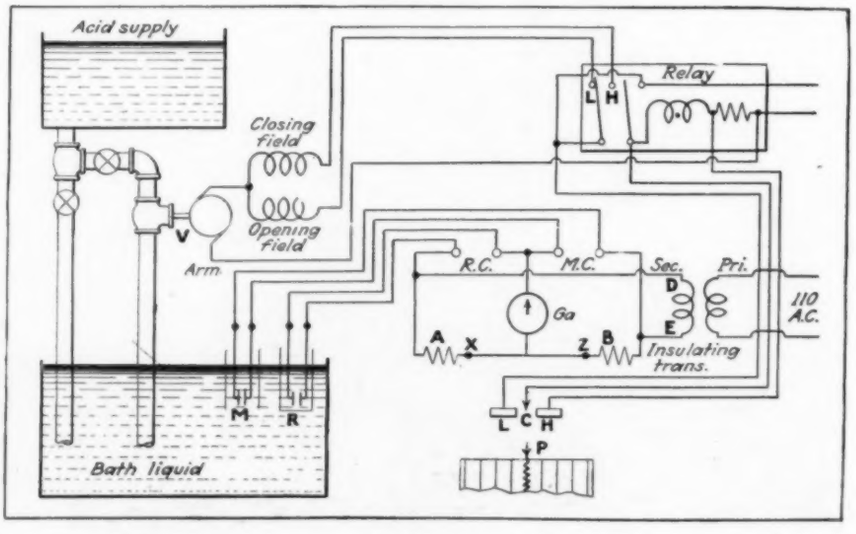


Fig. 2—Schematic diagram showing the layout of the bath, the acid supply and the control apparatus

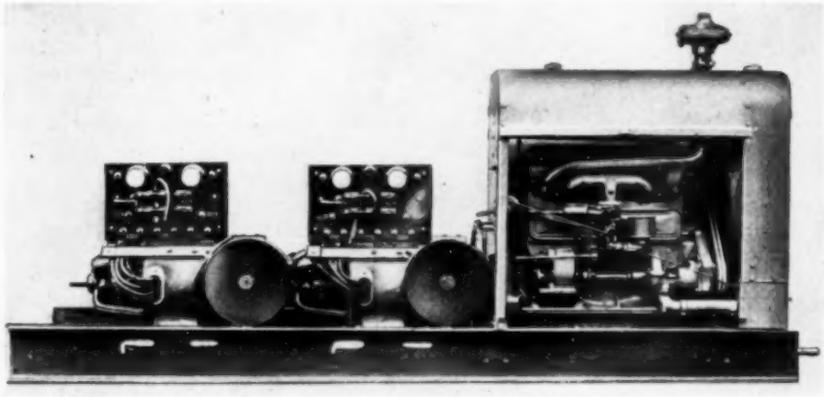
control operation. The recorder is calibrated so as to show the ratio of the actual bath strength to the desired strength. With this calibration, the actual acid percentage is apparent instantly, and the machine uses standard instead of special chart paper. If desired, the instruments can be furnished that are calibrated in per cent, but this involves an extra charge.

"Dualarc" 300-Ampere, Two-Operator Welding Outfit

TWO generators, each capable of supplying 300 amp. for metallic or carbon arc welding, are incorporated in the "Dualarc" two-operator welding outfit announced by the Electric Arc Cutting & Welding Company, 152 Jeliff Ave., Newark, N. J. Practically one-half of the gasoline consumption needed by two separate 300-amp. welding outfits is required by this apparatus, which consists of two 300-amp. generators placed in line and driven through a common shaft by the engine. This low gasoline consumption obtains from the fact that no appreciable difference in fuel requirements will be noted for an engine if two generators rather than one are coupled to it, due to the high idling speed necessary to maintain a constant minimum voltage. Units having the same characteristics of design were described on page 1024, Vol. 68 of the *American Machinist*.

A 40-hp. Continental engine is used to drive this two-operator outfit, the engine being of the four-cylinder, four-cycle type. It is equipped with a Zenith carburetor with the jet adjusted for the full arc-welding load or the air-compressor load. The gasoline consumption on continuous welding is $\frac{3}{4}$ gal. per hour, and for continuous compressing it is $\frac{3}{8}$ gal. per hour. A large-size truck-type six-row tubular radiator is supplied. The fan blower may be equipped with either ball or plain bearings.

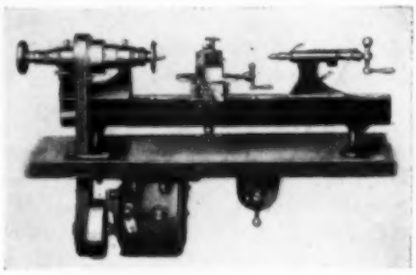
Power is taken from the engine by means of heavy truck-type double flexible couplings. The generators are of 300 amp. a.c. or d.c. They are equipped with transformers for supplying current to light drills and grinders. Complete welding accessories are furnished. An air compressor is mounted on a hinged base so arranged as to be lifted easily in or out of gear, and it is equipped complete for operation. The entire unit is mounted on a channel base and hoods may be supplied.



"Dualarc" 300-Ampere, Two-Operator Welding Outfit

Stark Motor Drive Unit

A compact and efficient motor drive for bench lathes and bench milling machines of Stark and other standard makes is being announced by the manufacturer, the Stark Tool Company, Waltham, Mass. The motor drive unit is mounted beneath the bench on which the lathe or miller is located and drives the spindle by means of a single belt, eliminating overhead shafting and belting, and leaving the bench space entirely clear. Six spindle speeds are available, three by shifting a lever and three others by using the other step of the cone driving pulley. These speeds cover the ordinary working range and may be had in reverse by reversing the motor.



Stark Motor Drive Unit mounted below a Stark No. 4 Bench Lathe

The motor drive unit is designed on the "sliding key" principle, and has a built-in speed reduction. Quiet operation is obtained by the use of non-metallic driving gears meshing with others of hardened steel. The three shafts are mounted in Timken roller bearings, which are lubricated constantly by a bath of oil. The simple expanding clutch has only four moving parts, is smooth and powerful in operation, and is controlled either by the usual treadle or a convenient hand lever.

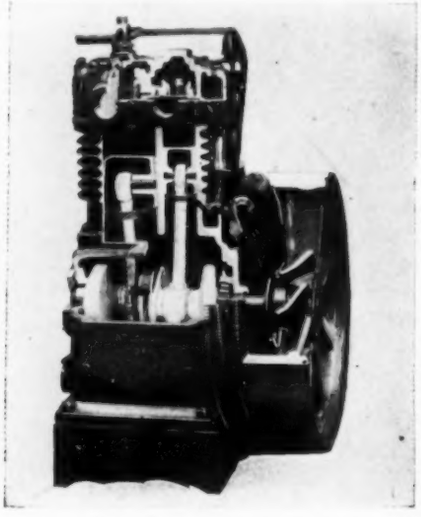
Regular equipment consists of a baseplate, reduction gear, and flexible coupling for the motor. The motor and its control are extra. A $\frac{1}{2}$-hp., 1,725 r.p.m. motor is used, which should be reversible if reverse speeds are desired.

Curtis Timken-Equipped Air Compressors

Coincident with its 75th anniversary, the Curtis Pneumatic Machinery Company, of St. Louis, Mo., has placed on the market a new series of air compressors, known as the 75th Anniversary Line of Timken-Bearing Compressors. The new machines are intended for industrial plants where a supply of compressed air for intermittent service is required for air hoists, spray painting, door openers, etc., and for garages employing air tools, such as drills and riveters, and needing air for tire inflation, car washing and similar service.

Eleven models, ranging from $\frac{1}{4}$ to 5 hp., and from 150- to 200-lb. pressure, are manufactured. These are of either stationary or portable type, with or without tanks, and for motor, gasoline engine, or line-shaft drive. Automatic or manual starting and unloading devices are provided, as

desired. There are three general classes: Single-cylinder, single-stage; two-cylinder, two-stage (duplex); and two-stage. All are of vertical construction. The first two are for intermittent service under pressures not exceeding 150 lb., and are either air- or water-cooled. The two-stage type is for either intermittent or continuous service under pressures



Curtis Timken-Equipped, Two-Stage, Air-Cooled Compressor, cut away to show interior

from 150 to 200 lb., and is air-cooled.

Crankcases, with integral bases, and cylinders are of heavy, cast construction. Air-cooled units have large radiating vanes on the cylinders. Sub-bases to raise pulleys clear of the floor can be furnished, where required.

Cylinder walls are honed. Pistons, piston rings, piston pins of hardened steel, and shafts are ground to size. Crankshafts are of drop-forged steel, with integral forged counterweights. Connecting rods are drop-forged H-sections with clamped pin end construction.

Main bearings are of Timken tapered-roller type. These bearings hold the shaft rigid, take up end thrust, and are designed to keep oil in and dirt out. Connecting-rod bearings are of two-piece, non-cutting, die-cast white metal.

The "Centro-ring" oiling system adopted consists of a ring running in an undercut groove on the crankshaft, picking up oil from the crankcase and delivering it to a chamber in the crankshaft. By centrifugal action the oil is thrown on distributing ribs within the crankcase, which carry it to all points requiring lubrication. A vacuum breather at the lower end of the cylinder prevents compression in the crankcase and eliminates leakage of lubricant. A high-and-low-level, oil-filling gage, a drain plug for emptying the crankcase, and a construction preventing oil from entering the air delivery system and causing tank explosions, complete the lubricating provisions.

Suction and discharge valves, with their seats, are combined in a nested valve-assembly. Discharge valves are thus cooled on the suction stroke, reducing compression temperatures. Valves are of disk type, light in weight, large in area, with short travel and small clearances. A keeper nut holds each valve-assembly in place.

Two-stage compressors have either a single or a double coil intercooler system consisting of a copper tube mounted on the high-pressure side. Continuous integral fins on the intercooler increase its radiating surface. The flywheel is equipped with fan blades which increase the cooling by forcing air over the coil. Flat belt pulleys, either tight or loose, as desired, are furnished with the compressors.

"Perfection" Wire Stripper

The "Perfection" wire stripper just announced by the Weber Machine Corporation, 33 South Water Street, Rochester, N. Y., incorporates a number of improvements over the Mahan centrifugal wire stripper from which it was developed, and which was described in the *American Machinist*, page 791, Vol. 68. The original design of this machine was developed and marketed by C. B. Mahan, of

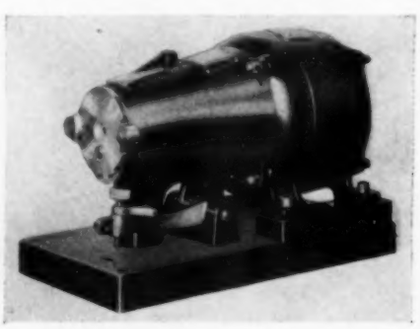


Fig. 1—"Perfection" Model A Wire Stripper, with direct-motor drive

Fig. 2—"Perfection" Model B Wire Stripper, mounted on stand and belt-driven

Rochester, from whom it was recently acquired by the Weber Machine Company.

The new machine is designed to put wire stripping on a production basis. It removes all kinds of insulation from the ends of stranded tinsel, multi-conductor cable, or wire up to ½ in. in diam. A new cutting edge may be obtained on the circular, alloy-steel knives by turning them slightly. When worn they can be quickly replaced at low cost.

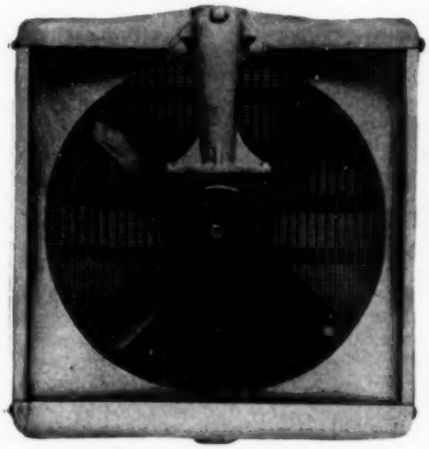
The machine is equipped with ball bearings throughout, and is readily adjusted to handle different lengths and diameters of wire. Model A, Fig. 1, is direct-connected to a motor, the type depending on the current to be used. Model B, Fig. 2, is designed for use where unlimited lengths of wire, or taps at any interval along wire, are to be stripped. It is mounted on a stand, and is belt-driven from its motor. It can also be mounted on a bench and driven from a lineshaft. Both models can be connected to any lamp socket.

Young Unit Heaters

For the heating of factories, shops and warehouses, the Young Radiator Company, Racine, Wis., has developed a series of unit heaters. These heaters may also be used for combined heating and ventilating service, and for drying, heating or cooling in

production processes. Either steam or hot water is supplied through an inlet pipe, 1¼ to 2 in. in diam. and discharged through a ¾- to 1-in. return connection. The condenser consists of flattened vertical copper tubes designed for maximum heat diffusion, to which are fused rows of flat copper fins, tapered slightly downward, for additional strength and radiation. Condenser tubes are brazed to the header plate. The units will withstand 125-lb. steam pressure; ample allowance has been made for expansion and contraction, and freezing will not burst the condenser. Units are self-cleaning, due to their straight, flat construction.

Air is circulated over the heating unit by means of a motor-driven fan. The largest unit has a ⅙-hp. motor, costing approximately one cent per hour to operate. A three-speed motor is furnished where desired, the top speed for rapid increase of room temperature, and lower speeds for normal operation. Motor bearings are wool-packed and will run 2,000 hours without additional lubrication, according to the manufacturer. Thermostatic



Rear view of the Young Unit Heater

control is provided at a little extra cost.

Adjustable deflectors throw the current of heated air downward, establishing practically uniform temperatures between floor and ceiling. Units are light in weight, can be suspended from steam mains, 8 to 12 ft. from the floor, without additional support, and can be placed in operation within a half hour after mains and returns are installed. The unit can be faced in any direction at any time, and started or cut off individually at will. The largest unit weighs only 125 lb., occupies a space of less than 3 cu.ft., is rated as delivering more effective heat than 5,000 lb. of cast-iron radiation, and will condense more steam than 600 sq.ft. of cast-iron radiation.

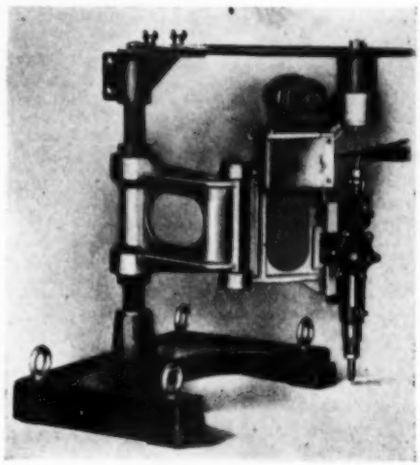
Unit heaters are reported to have shown a saving of from 25 to 50 per cent in fuel consumption, and have cut certain heating, cooling and drying operation times in half. In summer they can be used as cooling fans, or cold water can be circulated through the units to obtain still lower room temperatures.

Airco-Davis-Bournonville No. 4 "Camograph" Plate Cutting Machine

Production cutting of steel plate to various shapes by means of the oxy-acetylene flame can be done on this No. 4 "Camograph," announced by the Air Reduction Sales Company, 342 Madison Ave., New York, N. Y. The torch is mechanically carried and traversed, and is also positively guided to produce the desired shapes by the use of cams of either the internal or closed type or of the open form so designed as to produce straight or curved line cutting. Cams can be removed or replaced quickly since they are held in the bracket by means of two winged nuts or thumbscrews.

As shown in the accompanying illustration, the machine comprises a 13x20-in. U-shape base, in which is fixed a vertical steel post, to which the moving parts are pivoted. The post also supports a cam holder at the top. The mechanism includes two hinged aluminum arms mounted on Fafnir ball bearings, and a hand-operated vertical slide on the end of the outer arm, which carries a cutting torch, motor, switchbox, gearing, and electromagnet.

The magnet core is the vertical steel cam roller driven through reducing gears by the motor. The upper end of the roller is knurled, and is strongly attracted to the cam surface when energized by the powerful magnet. As the cam roller slowly rotates and passes along the outline of the internal cam by virtue of the traction afforded by the knurling, it carries the hinged arms and the cutting torch with it. The magnet consumes approximately 15 watts at 110 volts. The torch beneath the roller describes the same path as does the roller and cuts the form from the steel plate beneath its tip. The cams used are machined to the shape to be cut, making due allowance for the diameter of the cam roller, width of kerf, and finish, if any is desired.



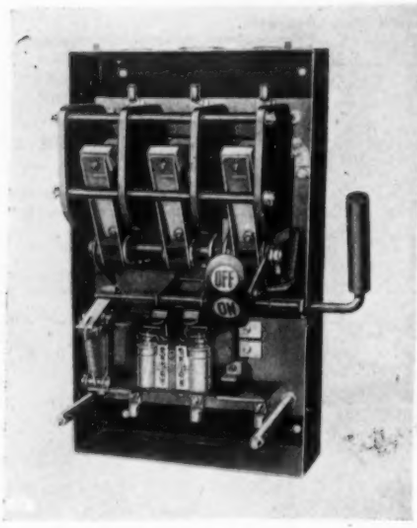
Airco-Davis-Bournonville No. 4 "Camograph" Plate Cutting Machine

The machine base has an arch beneath the post that admits a section ⅞x16 in. and provides for feeding plate stock from the rear, when cutting would be facilitated by so doing. The motor is started and stopped by a thumb switch beneath the switchbox, and the magnet is energized by a ball hand switch besides the starting switch. This distinction is made so that the operator can locate either by feeling. The cutting speed is varied by a motor governor.

The vertical movement of the slide and torch is 5 in. and the largest circle that can be cut is 14 in., the maximum reach being 18 in. The largest segment cut back of the post is 13x33 in., and the cutting speed is variable from 2½ to 28 in. per min. The direction of the rotation of the magnetic roller is always clockwise. Weight of the complete Camograph is 150 lb. The motor consumes 75 watts at 110 volts.

Roller-Smith Type EAF, Free-Handle, Inclosed Circuit Breakers

A line of small, inclosed air-break circuit breakers, known as the type EAF, are offered for the protection of motors and feeder circuits against



Interior view of the Roller-Smith Type EAF Inclosed Circuit Breaker

overload and failure of voltage by the Roller-Smith Company, 233 Broadway, New York, N. Y. All of these breakers are of the free-handle type, that is, non-closable on overload. Overload coils are standard equipment on either the two- or three-pole combinations and time-limit protection is afforded by means of simple and efficient dashpots. Either one or two under-voltage attachments can be placed on any size breaker without modifying the original structure. If it is desired to open a breaker from a distance by means of a shunt coil, a shunt trip attachment can be added without modifying the equipment.

The type EAF breaker is inclosed in a two-piece steel case so designed that the cover may be completely removed from the bottom by simply taking off two wing nuts. The breaker proper is mounted on a slate panel and this panel may be removed from the case during wiring. A target indicates the "open" and "closed" position. All breakers are equipped with a barrier unit separating the arcing members from each other, and this unit may be removed without tools. Plenty of wiring space is available at the top and bottom, and knock-outs are provided at the top, bottom, and sides.

REVIEW · OF · RECENT · PATENTS

Relating to the Machinery and Metal Products Industries

Metal-Working Machinery

A patent on a roll grinder, 1,700,422, was assigned to the Farrel-Birmingham Co., Inc. In the machine the grinding wheel is mounted on a base, which is movable on a sub-base on the carriage. The latter reciprocates relatively to the work and the sub-base pivots upon the carriage.

A center-drilling machine was patented, 1,700,668, and assigned to the Wyman-Gordon Co. In the machine the tool is moved to the work hydraulically, and is controlled and reversed automatically.

A drum-type milling machine was patented, 1,700,309, and assigned to the Niles-Bement-Pond Company. The patent covered a machine having two opposed side housings supporting a work-rotating drum and two cutter spindles on each housing.

Parts and Mechanisms

A cleverly designed pressed- or spun-steel pulley was patented, 1,700,416, and assigned to the Spun Steel Corporation. For rope or cable drive the pulley contains a number of grooves with disk flanges that are bolted tightly together on a hub.

Three lubricant compressors were patented, 1,700,471, 1,700,509 and 1,700,527, and assigned to the Alemite Manufacturing Corporation. The first of these comprised a plunger and cylinder pump and a control cylinder, which is subject to the discharge pressure of the pump. The discharge port is uncovered by the control cylinder piston. The second patent covers a rotating barrel with a discharge conduit, which rotates or swivels on the coupling. The third one was for a barrel-type with a reciprocating cylinder mounted on the outlet tube. The outer end has a pistol hand grip.

A molded gear was patented, 1,700,605, and assigned to the Westinghouse Electric & Manufacturing Co. It consists of a number of disks of fibrous sheet material, the alternate disks having different diameters, and superimposed rings of similar material around the disks, the disks and rings arranged to stagger the joints. The whole is consolidated with a hardened binder.

A toolholder patent, 1,700,610, was issued to Bernard H. Drees, of Cincinnati, Ohio. The tool sets into a groove in the holder, and is held down by an apertured head bolt, which is tightened from the bottom.

An anti-friction lathe center was patented by W. Reuen Fisher, 1,700,837. The center differs from the usual anti-friction center in that it has two sets of tapered roller bearings, one set of which is backed up by means of a strong square-wire spiral spring.

Trade Publications

FIBER. The National Fibre & Insulation Co., Yorklyn, Del., has published a catalog showing the various types of sheets, tubes, rods, and specialties of fibre manufactured. Lists of uses in various industries are included as well as price lists and discount sheets. The catalog contains 32, 9x6-in. pages.

GEARS, STOCK. The Ohio Gear Co., 1333 East 179th St., Cleveland, Ohio, has published Catalog No. 29, listing the various types of gears and other power transmission apparatus carried in stock. A good portion of the catalog is taken up with tables and formulas. The catalog contains 64, 7½x4¼-in. pages.

PUMPS, ROTARY. The George D. Roper Corporation, Rockford, Ill., has published Catalog No. 54, which is a very exhaustive booklet designed to aid the purchaser in choosing rotary pumps. The catalog illustrates and describes rotary pumps for coolant and lubricating purposes in factories and machine shops. It is plentifully illustrated throughout and shows capacity and horse-power performance curves for every type. The catalog contains 80, 11x8½-in. loose-leaf pages.

ROLLER BEARINGS. The Timken Roller Bearing Co., Canton, Ohio, has published a catalog entitled, "Wherever Wheels and Shafts Turn," which covers the general subject of the application of Timken bearings to all sorts of automotive, railway, and industrial equipment. The first part is devoted to showing the various types of equipment upon which these bearings are mounted and the types of mounting used on each. The second part of the catalog contains technical information on bearing mountings and installation. The catalog, which contains over 298 illustrations is printed on fine, glossy paper, with an artcraft binding. It contains 149, 9x6-in. pages.

ZINC, SLAB AND ALLOYS. The New Jersey Zinc Co., 160 Front St., New York City, has published a small loose-leaf technical bulletin giving the various types of slab zinc manufactured and the properties of "Zamak" die-casting alloy. In addition, the specifications and uses of the types of slab zinc are included. Technical material includes the standard methods of chemical analysis of slab zinc.

News of the Week

McGraw-Hill Buys "Aviation"

READERS of *American Machinist* will be prominent among those intrested in the announcement that *Aviation*, the oldest and strongest paper in the aeronautical field, has been bought by the McGraw-Hill Publishing Co., Inc. They have not been slow to realize that the aviation industry bids fair to offer a market for production equipment, tools, materials and parts that will be second only to the somewhat older automobile industry.

The editorial pages of *American Machinist* have been full of articles, editorials and illustrations published to show the advance of the art of flying, to promote that advance and to indicate its market possibilities. At times the editors have had the uncomfortable feeling that they were meriting the designation of propagandists, but their faith in the future of aviation has been so positive, and their conviction that its rapid development would be beneficial to the whole world that they have gone ahead without reservation.

In view of this interest they look with enthusiasm on the addition of *Aviation* to the list of 25 business papers through which the company is serving industry, business and engineering. *Aviation* has always been a good paper. With the full resources of McGraw-Hill behind it there is no question but that it can rise to new altitude records.

The paper will continue to be published in New York but at the address of McGraw-Hill, Tenth Ave. at 36th St., and the present staff will continue to function.

J. H. McGraw's Comments

In his announcement of the change of ownership, James H. McGraw, chairman of the board, McGraw-Hill Publishing Co., had this to say: "Aviation is now becoming a vital tool of modern business, and a new basic industry is in process of development. McGraw-Hill desires to contribute to the progress of aviation a publishing service that will provide every facility of modern industrial journalism to aid in the solution of its inherent problems.

"We assume the publishing direction of *Aviation* with the conviction that the resources of the McGraw-Hill organization will bring new strength to this paper and practical benefits to the industry beyond the reach of a single publication. We enter this field only because it is clear that there is an opportunity to render a service that will advance the art of flying and its economic development. We are glad to welcome into our organization a group of men of the type responsible for the splendid record and fine prestige that *Aviation* now enjoys."

Machine Shop Practice Meeting in Chicago

A joint meeting of the local machine shop practice division of the A.S.M.E. and the Western Society of Engineers is to be held in the Engineering Building, 205 Wacker Drive, Chicago, on March 18. There will be afternoon and evening meetings. At the first, Harold Greenhill, of William P. Greenhill & Sons, Chicago, will preside, while at the second, Frank W. Curtis, Western Editor of the *American Machinist*, will officiate.

The papers to be presented and their authors are as follows:

Commercial Status of Carboloy, Its Characteristics, Capabilities and Limitations, by G. N. Sieger and E. G. Gilson, of the Carboloy Co., New York.

Cylindrical Grinding, by R. E. W. Harrison, of Cincinnati Grinders Incorporated.

Principles Involved in the Design of Products Made of Pressed Metal, by R. I. Miner of the Youngstown Pressed Steel Co.

Nitriding of Steel and Its Practical Application, by H. W. McQuaid, of the Timken Detroit Axle Co.

Magnetic Testing Methods for Determining Flaws in Steel, by A. V. de Forest, of the American Chain Co.

Financial Reports Show Gains

The Timken Roller Bearing Company reports for 1928 a net profit of $13,730,145 after depreciation, interest and Federal taxes, compared with $9,554,397 in 1927. After payment of dividends, $7,836,057 was added to surplus, bringing this account up to $33,515,397, compared with $25,679,340 at the end of 1927. Current assets on Dec. 31, last, were $27,073,381, including cash of $223,487 and securities of $17,409,369. Current liabilities were $4,467,390. In a letter to stockholders accompanying the report, H. H. Timken, president, said the company during 1928 had expended approximately $8,300,000 in plant construction and improvement, while during 1929 $4,500,000 would be expended similarly.

The American Locomotive Co. and subsidiaries including the Railway Steel-Spring Co. report for 1928 a net income, including tax refunds, of $4,171,295 after depreciation, Federal taxes and other charges, compared with $6,391,277 in 1927. After payment of $6,160,000 in dividends on the common stock last year there was a deficit of $4,683,705, against a deficit of $2,463,723 after common dividends of the same amount in 1927. Total assets at the end of 1928 were $108,092,521 and the surplus was $23,531,312, against assets of $111,387,163 and surplus of $28,215,016 at the end of 1927. Current assets exceeded current liabilities by $44,962,862.

The Minneapolis Steel and Machinery Co. and subsidiary companies report net earnings for 1928 of $1,414,273 after depreciation, interest, reserves, and federal and Canadian income taxes, an increase of 73 per cent over the earnings of 1927, which were $817,241. Earned surplus on Dec. 31, 1928, after deduction of depreciation on plant for the years 1921 to 1925 and other special deductions, was $1,036,136.

Report of Doehler Die Casting Co., Brooklyn, N. Y., for the year ended December 31, 1928, shows net profit of $608,380 after depreciation and federal taxes. This compares with $389,577 in 1927. Earnings for 1928 were the largest in the firm's history. Sales for the year totaled $8,341,253 against $6,640,729 the previous one.

Smaller net income is reported by the United States Hoffman Machinery Corporation, and subsidiaries, for 1928. The net income in 1927 was $1,196,610, whereas in 1928, it was only $953,243. This is due in part to the acquisition of a new plant in December.

The Lakey Foundry Machine Co. reports a net profit of $1,006,883 for the year ended October 31, after all charges, equal to $3.52 a share on the capital stock. The preceding year showed earnings of $1.67 per share.

The report of the Marlin-Rockwell Corporation and its subsidiaries for 1928 shows a net profit of $2,511,897 after depreciation, charges and federal taxes, compared with $961,086 in 1927.

The report of International Silver Co. for year ended December 31, 1928, shows net income of $1,656,824 after depreciation, interest and federal taxes, compared with $1,857,854 in 1927.

The Sullivan Machinery Co., Chicago, reports for 1928 a net profit of $916,762 after depreciation, federal taxes and other charges, compared with $917,510 in 1927.

The statement of the Chicago Pneumatic Tool Co. for the eleven months ending Nov. 30, shows a net profit of $1,097,300, or $11.67 net earned per share.

British Overseas Trading Declined in 1928 But Machinery Exports Gained

By Our London Correspondent

WHILE last year Great Britain increased the value of exports of her own productions to £723,427,455, the total overseas trading showed a net decline, as imports were down at £1,196,940,354 and re-exports, at £120,-352,491, also showed a decline. It will be seen that the total exports amounted to £843,779,946, and it is natural that these figures should be officially given as they relate to shipping. On the other hand it may be pointed out that the net effect internally is possibly better shown if re-exports are deducted from imports, making the net imports £1,076,586,863. The so-called invisible balance remains the same, however the calculation be made.

The value of imports of machinery as a class amounted to £16,731,445, an increase during the year of £812,399. Exports of machinery totalled £53,749,-131 in value, an increase in the year of £3,828,288. Re-exports of machinery were valued at £1,635,683, an increase of £150,109. Imports of electrical goods and apparatus, valued at £4,711,-335, showed an increase of £454,502, the corresponding exports being valued at £11,629,139, a decline of £249,136, and re-exports in the same class totaled £167,267, an increase of £18,893, as compared with the previous year. These are the classifications as adopted by the British Board of Trade, and the entries are not necessarily strictly comparable with those under similar headings in other countries.

Machine Tool Exports

The European edition of the *American Machinist*, as usual, obtained a special official return regarding British overseas trading in machine tools during 1928, the total exports under this heading amounting to 14,554 tons valued at £1,770,127 or about £122 per ton. Shop tools, including milling cutters, etc., exported during the year were valued at £649,046. Machine tool imports were in quantity 8,790 tons, valued at £1,404,059 or about £159 per ton, small tools being imported to the value of £640,709. Machine tool re-exports totaled 309 tons in weight and were valued at £54,708 or say £177 per ton, re-exported small tools being valued at £107,661. Deducting re-exports from imports, it will be seen that the net imports of machine tools were valued at about £1,349,351 and were exceeded in value by machine tool exports of British production by £420,-776, an increase of about £27,000, as compared with 1927.

Of the various classes of machine tools, lathes as a whole are still most important, being exported to a total weight of 5,178 tons valued at £643,514 and imported to a weight of 1,740 tons valued at £266,112, the corresponding values per ton being £125 and £153 respectively. In exports, drilling machines come next in weight, with grinding, milling, shaping machines and presses sent abroad about equal. Looking at all the various classes, in every case imports were of higher value per ton than exports except as regards milling machines.

As to the distribution of machine tool exports, out of a total of £1,770,127, the various countries of Europe took British machine tools to the value of £548,741, British India £427,304, Australia £155,503, and South Africa £127,780, the rest being to countries not specified. To judge by the figures, South Africa is definitely improving as a market, while India remains fairly stationary, and Australia shows a decline, some increase in trading being exhibited as regards European countries.

Some Tool Firms Active

Some of the machine tool firms serving the comparatively light branches of engineering have been rather busier of late and firms that specialize in the heavier tools are also in a decidedly happier position, though this may be due to the weeding-out process that has been evident for several years. Thus one company now embodies, in all, four of the oldest and, one would have thought, the best-established machine tool concerns and, if reports are to be believed, another firm will either have to make fresh financial arrangements or close. Again, one of our largest engineering firms, which formerly incorporated a machine tool section, has had to write off losses accumulated since the war period amounting to more than 14 million pounds. Of these losses reduction in book values of works, plant and machinery is put at something approaching 5 millions. A capital reconstruction scheme is therefore being placed before shareholders, the alternative, according to the directors, being receivership.

The motor industry, on the production side at least, has been much more lively in anticipation of the coming season. Vehicles of American design are being built to an increasing extent on this side, the latest being the production of Chevrolet commercial vehicles. The establishment too of American tire manufacturers in Great Britain may be noted.

The improved conditions of most of the British shipbuilding areas last year is demonstrated by the statement of Lloyd's Register to the effect that the total British output was 1,445,920 tons, an increase on the year of 220,000 tons. This British output formed more than 53 per cent of the total world output of 2,699,239 tons gross. Exports amounted to about 20 per cent of the total British production. Of the latter the Clyde produced nearly one-third and the only important district to show a decline was Belfast. Of other countries Germany, launching the two largest vessels of the year, came nearest to Great Britain with a tonnage of 376,416, or considerably less than that produced on the Clyde alone. The United States new tonnage is given as 91,357.

The airplane industry, which does not seek much publicity, is well occupied, and lately more orders have been secured, particularly for engines for export. The industry will probably be further helped by the scheme by which the government will subsidize a new air company for three years at a maximum of £15,000 per annum and at a lower rate for 7 years after. A number of new aerodromes and landing grounds have also to be provided.

About nine years having passed since an international exhibition of aircraft was held in London, the Society of British Aircraft Constructors has arranged to hold another in Olympia, London, W., from July 16 to 27. The Society of Motor Manufacturers and Traders, who are also associated with the aircraft exhibition, will hold their usual international motor show at the same place from October 17 to 26, and the bi-annual commercial motor exhibition will be held from November 7 to 16, followed by the motor-cycle and cycle exhibition from November 30 to December 7, also at the same place.

Spain Improving as an Export Market

From an industrial point of view, new Spain is extremely interesting as an export market. Second to the United States in wealth on a per capita gold basis, she is undertaking extensive programs of public work developments in transportation, airports and airplanes, hydro-electric power, roads, railways and construction, of industrial buildings, harbors, and naval bases. This industrial development necessitates the importation of much machinery. More than 25 per cent of everything Spain imports comes from the United States. During the last ten years her imports have increased 500 per cent, the United States during the past five years having doubled her exports to Spain of industrial machinery. Over the same period light machine tools showed a loss, partly due to a business depression in Spain, and partly to government protection of a factory in the Balearic Islands.

Great Britain enjoys the bulk of the heavy machine tool trade in Spain, while Germany is the largest source of lighter equipment. Great Britain showing 58 per cent on weight over 10,000 kg. and Germany 54 per cent on weight up to 500 kilograms.

As regards textile machinery, which is the most important single item in in-

dustrial machinery imports, the United States is fourth on the list. Being predominantly agricultural, Spain offers important possibility as a market for tractors. American makes predominate, with notable growth during the last three years. The light wheel type is preferred to the caterpillar type. Besides being used in agriculture, tractors also find employment in construction work and road building. The United States is also Spain's largest source of supply for internal combustion engines.

Swiss Machinery Exports Increased in 1928

By Our Paris Correspondent

FROM Zurich comes the report of the satisfactory operating of the Swiss machinery trades in 1928. During the year the export of machinery, tools, mechanical prime movers and vehicles, not including instruments and apparatus so classed, exceeded the value of the exports of 1927 by a sum approximating 10 million dollars. The showing is remarkable considering that the country is entirely bereft of raw materials, even coal. This export had a total value of above 60 million dollars. Allied therewith may be included aluminum metal exports of another 12 million dollars in value.

Product of the metal industries absorbed by the domestic market was 60 million dollars, fairly evenly divided between machinery and metals in more or less finished or fabricated forms. This volume might well have been greater except that the government railway electrification schemes, which had bolstered up the electrical machinery industries, are fast nearing completion.

Both in domestic and foreign markets Swiss metal products have withstood a live comp tition with success, considering that production conditions in many countries are infinitely better than those in Switzerland. A point is made that wages in many like industries in foreign countries are from 10 to 50 per cent of what they are in Switzerland where the gold franc is worth five times that of the French franc, for instance, though before the War both were at par. Another point emphasized is that the 8-hour law in Switzerland has fewer derogations than that allowed by legislation in certain other countries—in this case probably referring to Germany.

Profits Were Less

Though a largely increased volume of business was consummated in many lines, selling prices were a more near approach to production costs than previously, only certain quasi-monopoly products holding to the former price scale. For the sake of capacity output and the desire that labor should be as fully employed as possible, business was accepted in many quarters at close profits, a procedure which was considered indispensable if carrying charges and depreciation were to be liquidated, and customers, who might otherwise be induced to place orders elsewhere, were to be held.

The improvement in Swiss economic and industrial affairs is believed to be due to economic improvement throughout the world and the stabilization of foreign exchanges. It is admitted, however, that the Swiss machinery trade *per se* is seriously affected by the competition of France, Belgium, Italy and Czechoslovakia, where export goods are put out under a wage scale inferior to that of Switzerland, and where raw materials, either by direct transformation or by exchange of other natural resources, actually cost less in cash.

The observation is made that Swiss export trade has been affected also by the tendency of most countries to protect home industries by high tariff walls or by other economic concessions intended to encourage local national industries. The suggestion is made that future commercial treaties between Switzerland and other countries should be on a long time basis and thus enable Swiss industry to make plans and projects far ahead when seeking to develop foreign trade still further. The League of Nations at Geneva has suggested this same procedure at various times during the meetings of its economic council.

Raw Material Prices Stable

No complaint is registered as to the prices of raw materials which have remained virtually stable during the year, while a save-the-waste-campaign has been carried to its utmost by the recuperation of metal scrap which had hitherto been at least in part neglected. It is worth noting that the Roll blast furnace at Choindez, the sole existent in Switzerland, has been in operation for the first time since 1918. Foundries have been fully occupied for the machinery industries as well as other trades.

A consortium of Swiss banks, with, it is believed, American financial aid, has aided in developing certain machinery industries in order that extended credits may be given in export markets. This is in keeping with the financial aid that Swiss electrical industries have long enjoyed and shows the tendency of development of a country's industries branch by branch rather than firm by firm.

In the machinery industries, so far as figures may be garnered from annual reports, a full 6 per cent has been earned as compared with 3 to 5 per cent in the critical years between 1921 and 1925. The Swiss consider that this return is nothing more than normal and is in no way an exaggeration, not to the extent that industry is called upon to shave dividends in order to reduce prices. Mention is made, somewhat vaguely, of certain well-known industrial enterprises in the trade which have not been able, in spite of sincere effort, to pay dividends. These firms are believed, however, to be an exceptional minority.

Machinery Exports Show Big Increase in 1929

The first month of the present year closed auspiciously, as far as exports of industrial machinery are concerned, with foreign shipments valued at $20,776,000—an increase of 37 per cent over the corresponding month of 1928 and exceeding also the total of $18,636,000 for December, 1928. This total for January is substantially in excess of the monthly average of approximately $17,454,000 for 1928 and $15,014,000 for 1927, and represents the greatest shipments for any single month during the past seven years. The United States exports of industrial machinery have been tending steadily upward since the close of 1921, with the result that the exports for January 1929 were more than double the average monthly shipments for 1922.

All of the principal classes of industrial machinery made substantial export gains over January, 1928, with the exception of textile machinery, which fell off slightly. The outstanding gains were in power, pumping equipment and in well and refinery machinery, the forming expanding by 113 per cent and the latter by 82 per cent. Exports of steam engines increased 62 per cent, internal combustion engines 47 per cent, mining and quarrying machinery 43 per cent, metal-working machinery 23 per cent, and construction and conveying machinery 14 per cent.

The gains in the metal-working machinery group were widely distributed among the various types. Exports of sheet and plate metal-working machines were nearly doubled, reaching a total of $236,000. The trade in foundry and molding equipment, with a value of $141,671, was more than treble that of the corresponding month of 1928. The exportation of ball and roller bearings was more than doubled, amounting to $369,450, all told.

Oil Burning Equipment To Be Exhibited

An exposition depicting the rapid development of the oil heating industry and modern oil equipment will be one of the features of the sixth annual convention of the American Oil Burner Association to be held, April 9-11, in the Hotel Pennsylvania in New York.

The exposition itself will include a display of everything that enters into the manufacture, installation and general use of oil burners and will be restricted to members of the Association.

Prominent officials representing the oil industry, the electrical industry, the automobile industry and the National Chamber of Commerce will address the convention.

BUSINESS BAROMETER . . . . . *Despite the enthusiastic reports that are coming in from nearly every industry, some prophecies of recession are beginning to appear*

By THEODORE H. PRICE
Editor, Commerce and Finance, New York

From this page the reader will get a quick picture of current business and industry. The boxed material below is a summary of the letters from regional correspondents of the American Machinist, published in full on the opposite page.

THE relation which the Federal Reserve authorities have assumed to the stock market brings to mind a story that was once circulated about an extraordinary method employed in China of putting criminals to death. According to the story the condemned man was blindfolded, and a lancet or a sharp knife was passed across his jugular vein but without inflicting a cut. Tepid water was then allowed to drop along the line of the vein, and the man was told that he was bleeding to death. Being under this illusion, he soon died, though his death was entirely the result of an imagined injury.

Whether intentially or not, the Reserve authorities appear to be following the same technique in their efforts to suppress the use of credit by the stock market. The self-induced death of speculation would rescue them from the unpleasant dilemma in which they find themselves in their endeavor to keep credit scarce and dear for the securities markets and abundant and cheap for business. It is difficult actually to kill stock speculations by depriving it of credit without doing equivalent injury to commerce and industry, but if the condemned man could be persuaded to die peacefully all would be well, and the credit tension, which becomes more potentially damaging to business the longer it endures, could be safely relieved.

Behind the warnings which are being issued, therefore, is probably a hope that they will prove effective without the necessity of further action than the moderate measures which have already been taken. Last week the Philadelphia Reserve Bank addressed a letter to its members advising them to reduce the volume of their loans on securities rather than borrow from the Reserve Bank. It is reported that the New York and some of the Western Reserve Banks have given similar advice, and it is highly probable that all twelve of the Banks have done so.

If these requests were being obeyed, brokers' loans and rediscounts should both be decreasing. In that light, the Reserve Bank statements issued last Thursday are particularly interesting. Loans to brokers by the New York member banks did not decrease; they increased $30,000,000, leaving them only $170,000,000 below the peak of three weeks ago. And rediscounts of the twelve Banks were not reduced; they rose $88,000,000.

It is true that the Reserve Banks have continued to diminish the credit base by selling government securities and reducing their holdings of acceptances; during the past three weeks there has been a decline of $110,000,000 in these items, which would have signified a reduction of $1,000,000,000 to $1,500,000,000 in the lending power of the member banks if it had not been offset by the increase of $100,000,000 in rediscounts.

As the stock market likewise has been buoyant and more active, and the price averages have climbed back to where they stood on February 6, when the Reserve Board's statement was issued, it appears that the authorities have been whistling in the wind.

The fact seems to be that speculation has become too indurated to Federal Reserve warnings to be killed by them alone. As last week's advance was accomplished in the face of rates of 9 and 10 per cent for call loans, it seems that even the weapon of dear money has been dulled, and it is not wholly fanciful to suggest that call money may go to 25 to 50 per cent.

Despite the enthusiastic reports that are coming in from nearly every industry some prophecies of recession are beginning to appear, and it is significant that they are based upon the premise that commerce and industry already are sharing moderately in the stock market's inflationary movement. Thus one of the New York banks points out five reasons for expecting that the expansion in business will soon reach its peak. These are: Prolonged high money rates; psychological effects of a stock market reaction on business confidence; improbability that high rate of automobile production can be maintained more than a few months longer; a moderate slowing down of construction, and a tendency toward excessive production in some industries.

But the first, second and fourth of these assume the rigorous continuance and complete success of the Federal Reserve policies, and the latter at least must now be held doubtful.

Meanwhile the news contains much that adds fresh fuel to speculation. The steel mills have further increased operations to between 90 to 95 per cent of capacity, and the automobile factories are turning cars out at the highest daily rate in their history.

In the commodity markets the speculative flame has broken out again. The list of important staples, which have been moving upward during the past two or three months, is now so long that it is likely some influence is at work which is common to all of them.

Mr. Hoover's administration therefore opens with business in a state of activity which has rarely been exceeded, and with a probability that its operations will be maintained at a high level for many months to come, unless the impact of spring demand for credit upon the Reserve Banks, which will have to raise their discount rates if they are to carry their present policies to conclusion, causes a tension which will impair confidence and discourage enterprise.

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MARCH prospects in the machine tool and machinery trades are the best since the War, according to reports coming from all sections of the country, although February was not universally a top-notch month. In Chicago, for example, February business was below January, although of a satisfactory nature, but inquiries are plentiful, indicating an active March. There has been a considerable improvement in the used equipment situation during the past month, however. In the South, there has been only a slight improvement in the volume of orders, but the tone and volume of inquiries have increased considerably. The movement of textile mills to the South is having its effect upon the machinery trade and will no doubt influence future business.

IN DETROIT an unusual number of orders and inquiries are being received, due largely to automotive activity. Even the small shops are buying equipment. Heavy sales were recorded in New England during February, which closed with an active week. The abatement of the "flu" there is allowing the tool builders to increase their production schedules to meet the present high demand. The question of deliveries is about the only sore spot in the New York market, where dealers and factory representatives are enjoying one of the most satisfactory periods in their history.

RAILROAD purchases of shop equipment are becoming more important. Orders and inquiries in the South indicate a lively market in this field. Cincinnati reports the receipt of several large lists from railroads, and in New York the N. Y. Central is prominent among the buyers. In Canada, purchases of rails, cars and locomotives is the chief factor in present industrial activity.

The Industrial Review

Weekly progress of the machinery and machine tool business

THE following reports, gathered from the various machinery and machine tool centers of the country, indicate the trend of business in these industries and what may be expected from the future:

DETROIT

With all of the automobile plants and accessory plants either working at capacity production or planning to get into full swing in the immediate future, the prospects for March in the machinery and machine tool field are particularly bright. Most of the dealers here report an unusual volume, not only of actual orders but of inquiries of all kinds. At present the tendency is toward tool and die room equipment. This seems to be an indication that the automobile plants are making preparations to turn out a large volume of cars in a hurry. The small shops are buying a great deal of equipment also, another indication of prosperity.

The entire automotive field with all of its ramifications seems to be in a particularly healthy and optimistic period. While sales of cars are not so great, there is every indication that the coming month will show a decided jump. Most of the automobile companies are improving their export trade and when the home market begins to feel the effect of spring it seems likely that a good many production records may be broken.

Almost without exception the body builders are busy and are making heavy purchases of varied equipment. Murray, Fisher and Briggs are the most active.

Two announcements by steel companies are of large interest this week. The formation of the Great Lakes Steel Corporation, an offshoot of the Michigan Steel Corporation, will bring about the erection of a $10,000,000 open-hearth steel plant in Ecorse. The other announcement is that the Newton Steel Co. has begun work on the first of its buildings in Monroe. Contracts have been let and the actual work of construction has been begun on a $60,000,000 steel development.

General business conditions in the Detroit area are very good, and employment is still going up.

CANADA

Machine tool dealers throughout Canada report a good demand for a wide variety of tools. Industrial conditions of the Dominion are highly satisfactory and point to well maintained employment for the first six months of the year at least. Rolling mills are busier than ever and are falling behind owing to the acute demand. The Algoma rail mill is still operating at full capacity on double turn. Particular significance attaches to a special rail order of several thousand tons just completed by Algoma for the Canadian National Railways in that it may be the forerunner of considerable additional business which heretofore was not thought could be produced in Canada.

The Standard Steel Construction Co., Ltd., has just completed the most successful month in its history, and the Port Robinson plant on the Welland Canal is operating to capacity, with plenty of work ahead. The company recently secured a contract from the International Nickel Co. of Canada for the steel construction work on two new buildings at Port Colborne. Business of Ontario Steel Products for the current year is reported to be running well ahead of the preceding period. The company benefited from the increased automobile production of last year, while demand for other lines has been on a heavier scale.

The Hamilton Bridge Co. have booked a $500,000 order from the Dominion Government for the construction of No. 6 bridge on the Welland Canal. Other orders to nearly the same amount are stated to be pending from other sources. Canada Foundries and Forgings, Limited, continue to show business growth. An important addition to the contract books recently is one for the supply of track tools of various types to the Canadian National Railways.

The de Havilland Aircraft Co. of Canada finds itself in the position of having orders in hand for a number of Moths exceeding the whole production for 1928. These include machines for the various departments of the federal government and for the Ontario Provincial Government Air Service.

SOUTHERN DISTRICT

Although machinery and machine tool inquiries have improved considerably during the past two weeks, orders have picked up only slightly, but are reported by most distributors to be satisfactory for this period of the year. The outlook is brighter than it has been in some time. Dealers are expressing the opinion that many of their present inquiries will develop some good orders within the next few weeks, and that during the spring months sales will be at least on a normal basis in this district.

Because of the movement of textile mills to the South, there is a large amount of such construction in progress. Work of this type started since the first of the year in Alabama, Georgia and the Carolinas amounted to several million dollars. Hence in this field the outlook is particularly good, most dealers predicting a much better than normal volume. Orders for new equipment are improving steadily.

Heavy shop equipment is also in fair demand from the larger railroads in the Southeast for their new projects now under way, and inquiries in hand indicate this business will also be better than normal during the next few months.

Woodworking machinery is moving fairly well in all of the southeastern states. The lumber industry is a fair buyer, brisk orders are reported from automobile body plants, and an excellent demand has come from some of the larger furniture factories in Georgia, Tennessee and Carolina, where the furniture industry is showing steady expansion and preparing for a brisk season. Lumber conditions are improving and the outlook is much better than it was two or three weeks ago.

The same conditions prevail in the garage and smaller machine shop field that have existed in the Southeast for several months, a few orders being placed for use or rebuilt equipment, but scarcely any orders reported for new equipment.

CINCINNATI

Machine tool manufacturers of the Cincinnati district report that the past week's sales were at a very good level. A slight increase over the previous week is reported by the majority of the concerns and none reported a loss. While February is pronounced a very satisfactory month by all, the prevailing opinion is that March will be still better. Scattered buying predominates, but while there are no large orders the aggregate buying is sustaining business in a very satisfactory way.

Orders received were well scattered over the different sections of the country and the requirements of the purchasers were well diversified in the matters of sizes and types. The purchases of railroads and concerns in the automotive field were almost entirely confined to single tools and replacements.

Inquiries flowed in freely during the week from all sections of the country. The great majority of the inquirers were general machinists and miscellaneous users, located in all sections of the country. Three good-sized lists from railroads are reported, these being the Santa Fe, the Illinois Central, and the Canadian Pacific.

CHICAGO

While activity in the machine tool market still generally prevails, reports from several sources are to the effect that business transacted during February, although still on a good and satisfactory level, did not reach that of January on the average. The falling-off was not material, however, and from all accounts will more than be regained during March. Inquiries are plentiful, and come from scattered territory throughout the Midwest. No lists additional to those already reported have been received from railroad interests, nor are any expected for the present.

The automotive accessory industry is a prominent buying factor at this time. Farm machinery and tractor builders are said to be preparing inquiries for a varied assortment of shop equipment which are expected to materialize in the near future, and reports are current that some steel mills in the Chicago territory will enter the market for a number of tools needed in their plants.

The recession noted in the demand for new machinery does not seem to have applied to used tools, the call for which during February has improved to a material extent. Manufacturers of grinding machinery and abrasives report business fully equal to that which has prevailed during the last several months, a condition they look to be maintained for an indefinite period.

NEW YORK

The statement made by a leading machine tool dealer to the effect that February, as regards machine tool sales, was the best month since 1920 and the most satisfactory in the history of this company due to the fact that sales were well scattered, about sums up the situation in the metropolitan district. In fact, all dealers and factory representatives are in a most optimistic frame of mind. One man stated that with the largest volume in some time, the biggest order was for only four machines, the others being for one and two machine lots.

There is every prospect of continued good business during the present month and for several to come. The most optimistic believe that the present high rate of activity will be continued for the next four years, while at the other end of the scale, one large builder predicts that a slump will occur in the latter part of the summer. Certainly present inquiries and orders in prospect indicate no interruption of the present trend.

The delivery situation is about holding its own in that, for the most part, it is getting no worse, except in a few isolated cases. For example, delivery on a certain type of machine is quoted for September or later. There is tangible evidence that the increased price trend, which started

two years ago, is continuing upward. In the past fortnight four concerns have announced price increases in grinders, presses, sensitive drills, and turret lathes, respectively. Local dealers look to further price rises.

It is expected that within the next week a large amount of the business for which inquiries were made a few weeks back will be closed by the General Electric Co. One of the chief buyers in the past week was the N. Y. Air Brake Co., of Watertown, N. Y. Among the machines bought were a horizontal borer, a shaper and a lathe. The International Motor Co. acquired a number of high-production machines during the past week. The New York Central bought two radials, among other equipment, and the Wright Aeronautical Corporation bought four lathes to replace existing equipment.

Sales made by the Triplex Machine Tool Co. during the past fortnight included: Two Swiss jig borers, two hand milling machines, four bench drill presses, three floor drill presses, two disk grinders, one Williams power pipe threader, two 16-in. Springfield lathes, one 24-in. shaper, one Excel filing machine, one Boley multiple spindle driller, three floor grinders and buffers, three Ames bench lathes, and one Ames bench miller.

NEW ENGLAND

New England machine tool builders enjoyed a month which as a whole averaged well above the corresponding month last year. The outlook is bright with manufacturers more concerned over the delivery of old orders than the volume of new sales. Early March finds production schedules less affected, due in no small measure to the abatement of the "flu" epidemic during February. The scarcity of skilled labor is a problem in some industrial centers of this section. Manufacturers believe that the situation will become more serious with continually increasing production in the automotive and aeronautical fields.

The week was steadily active. Orders received held to the fine level, which has been the rule for an extended period. Inquiries were lighter, however. Notable among the orders were items for grinding equipment, millers, planers, and large and small lathes in a variety of sizes. Automobile interests, parts manufacturers in the radio, electrical and aeronautical fields; and airplane builders were representative buyers.

Machine tool dealers have closed a good month. Some did better in February than in January. Prices as a whole have been higher, and there continues to be a strong demand for the better rebuilt tools. Small shops are using all available space for the installation of extra machines in an effort to meet scheduled requirements more fully.

Business Items

Work has already been started on the first wing of a 5-story building, 404x128 ft., to house the finish race grinding department of the New Departure Manufacturing Co., at Bristol, Conn. The first wing will be completed by May 1, and the second by the fall. Modern machinery, much of it designed by the company, will be installed, and individual motor drive will be featured. At the Meriden factory, a new 4-story wing, 200x106 ft., will be built, providing 80,000 sq.ft. additional floor space. One of the floors will house a modern heat-treating unit.

The Berger Manufacturing Co., Canton, Ohio, a subsidiary of the Central Alloy Steel Corporation, has acquired the metal furniture division of the Van Dorn Iron Works Co., of Cleveland, and will continue the manufacture and sales of the Van Dorn line of metal furniture at Cleveland, according to an announcement recently made by S. S. French, president of the Berger company. The purchase involved about $1,000,000 and it includes all the Van Dorn metal-furniture machinery, tools, and inventory in process. The Berger Co. also makes metal furniture and other special metal products, and during the year 1928 its sales aggregated over $12,000,000.

The Moline Hydraulic Jack Co., a $500,000 corporation, has begun production in its Moline (Ill.) plant and within a few months expects to have 50 men employed in its shops. A. E. Montgomery, president of the Montgomery Elevator Co. of Moline, is head of the new concern, which manufactures hydraulic-type jacks for automobiles, special jacks for factory purposes and other similar equipment. T. C. Pomeroy, inventor of the jack, is vice-president and D. Lambert Esterdahl, secretary-treasurer.

The Federal-Mogul Corporation, of Detroit, has established a die-casting division for handling the contract manufacture of die-cast parts, according to D. W. Rodger director of sales. Die-castings will be offered in a full range of zinc, aluminum and tin base alloys. The division will eventually be housed in an addition of 25,000 sq.ft. being made to plant No. 1 in Detroit. The company has recently developed and installed some fully automatic die-casting machinery.

Hoggson Bros., of New York and Chicago, and the Dresser Co., of Cleveland, have combined interests and have established offices in New York, Chicago and Cleveland and will also open others in Pittsburgh and in Charlotte, N. C. The Hoggson firm has specialized in the design and construction of bank buildings, while the Dresser Co. has confined its activities to commercial and industrial structures.

The Bridgeport Brass Co., Bridgeport, Conn., at its annual meeting February 26 added two new members to the Board of Directors, namely: F. Donald Coster, president of McKesson & Robbins, Inc., and a director of the Bridgeport Trust Co.; and Herman Steinkraus, sales manager of the company. During 1928 the company earned after all deductions $25 a share on its outstanding capital stock.

The City Auto Stamping Co., Toledo, has been formed to manufacture heavy stampings, such as automobile bodies, fenders and similar equipment. The new company is closely associated with the City Machine & Tool Co., Dayton, the stockholders of which have been offered rights to subscribe to the 150,000 shares of no-par common of the new company at $6 a share.

The Wisconsin Electric Co., 33 Sixteenth Street, Racine, Wis., manufacturer of fractional-horsepower motors, has changed its corporate title to Dumore Electric Co. to identify itself better with the trade-mark, "Dumore." The company also has increased its capital stock from 500 to 3,000 shares of common stock without par value.

The Metropolitan district offices of the Kearney & Trecker Corporation, of Milwaukee, Wis., the Landis Tool Co., of Waynesboro, Pa., and the Leland-Gifford Co., of Worcester, Mass., have been removed from the former location at 149 Broadway, New York, N. Y., to Room 658, 1060 Broad St., Newark, N. J.

The Ajax Electrothermic Corporation, Trenton, N. J., is preparing a film showing the operation of high-frequency induction furnaces. The total length of the reel will be about 800 ft. and can be provided in either standard or 16-mm. width. Copies will be available for use at meetings of engineers' clubs or societies within the next few weeks.

The Walker-Stewart Foundry Corporation, Plantsville, Conn., has filed a petition in bankruptcy listing liabilities at $50,090 and assets of $51,466. The plant employed 75 men, and has been closed for about one month. Victor E. Walker, Meriden, Conn., is president.

The Manganese Steel Forge Co. of Philadelphia, Pa., has opened a sales office in Pittsburgh at 1714 Clark Bldg. J. H. McKinley is in charge. The firm handles "Rol-Man" manganese steel screens and similar products.

The Machine & Tool Designing Co. of Philadelphia, has moved its office from 706 Chestnut St. to the Victory Bldg., 1011 Chestnut St. The firm does a designing and engineering service business.

Zimmer Bros. Co., 4520 Sixth Ave., Moline, Ill., has been organized by Henry A. and Walter H. Zimmer as distributors in the western Illinois and eastern Iowa territory for factory equipment, special tools and machinery.

The Century Electric Co. of St. Louis has opened a sales office in Indianapolis at 718 Continental Bank Bldg., and one in Omaha, Neb., in the Union State Bank Building.

The Jones & Laughlin Steel Co., Pittsburgh, Pa., opened a new Southeastern office in Atlanta recently at 1313 Healey Bldg. William Miller is in charge as district manager.

The Erie Malleable Iron Co., Erie, Pa., recently opened a new Southeastern branch in Atlanta at 701 Thrower Bldg., with E. E. Dawes in charge as district manager.

The Davenport (Iowa) Brass Foundry has filed petition in voluntary bankruptcy. Schedules have not been filed. George Meckel is secretary and J. B. Phillips, treasurer of the company.

Brandtjen & Kluge, Inc., has removed from 310 Cedar St., to 653 Gaultier St. (at Como Ave.), St. Paul, Minn.

The Southern Textile Machine Works, Chattanooga, Tenn., manufacturers of machinery, equipment and parts for textile mills, plans the establishment of a new plant at Chattanooga, this year.

Personals

B. W. DIMEND, who for the past several years has been in charge of the machine tool department of the Smith Booth Usher Co., of Los Angeles, Calif., has severed his connection with that company and has left for Honolulu on a short vacation. He was for a number of years connected with the Federal Machinery Sales Co., of Chicago, and later represented the Lees-Bradner Co. in the New York territory. No announcement of his future plans has been made.

H. S. GREENE, vice-president in charge of sales of the Barber-Greene Co., Aurora, Ill., has disposed of his holdings in that company and resigned his executive position and from the board. Mr. Greene is leaving upon an extended trip abroad and will spend considerable time there in connection with foreign sales of the company. W. B. Greene, his brother, succeeds him as vice-president in charge of sales.

HARRY DOBSON, formerly superintendent of the London (Ont.) and Montreal branch of the Ford Motor Co. in Canada and later with the White Motors and Chrysler Corporation has joined the staff of the Arthur Jackson Machine Tool Co., of Toronto 2, Canada, and will manage the new branch this company is opening in Windsor, Ontario.

FREDERICK S. BLACKALL, JR. was recently elected vice-president and general manager of The Taft-Peirce Manufacturing Co., Woonsocket, R. I., in place of his late father who died in October, 1928. The Taft-Peirce firm is engaged in the manufacture of special machinery on a contract basis as well as a standardized line of small tools and machinery.

WILLIAM K. SWIGERT, well known in automobile circles and until recently production manager of the Stutz Motor Car Co., has been appointed plant manager of the St. Louis (Mo.) plant of the Wright Aeronautical Corporation where the Gypsy engine is to be built for light planes.

GEORGE A. WHALON, who has for several years been a manufacturer's agent for machine tools, small tools and other machine shop equipment in Japan, has returned to the United States to become a machinery salesman for the National Acme Co. in the Detroit territory.

A. R. WEIGEL, former factory manager of the Velie Motors Corporation, Moline, Ill., has been appointed general manager of the Barnard & Leas plant in Moline. During his association with the Velie Motors he was chief of engineers in charge of production.

FRED D. BAKER, formerly associated with the Strong, Carlisle & Hammond Co., of Cleveland, has become associated with Charles H. Besly & Co., of Chicago, as sales engineer. He will represent the Besly interests in the Cleveland, Erie and Buffalo districts in the sale of Besly grinders and abrasive disks.

WILLIAM J. CRONIN, for the last nine years representing the National Metal Trades Association in the New York and New Jersey district, has been appointed secretary of the Tri-City Manufacturers' Association, with headquarters in Moline, Ill.

JOSEPH A. HOLLAND, well known for his connection with the National Metal Trades Association and in personnel work, has become sales manager of the Langelier Manufacturing Co., of Providence, R. I.

CHARLES E. DIEBOLD, formerly tool and machine supervisor in the shock absorber division of the National Acme Co., Cleveland, has been appointed sales engineer for the company specializing on Acme and Gridley automatics.

E. R. HANSEN has resigned as assistant superintendent of the Webster Electric Co., Racine, Wis., and on March 1 became identified with the Dumore Electric Co., also of Racine, formerly known as the Wisconsin Electric Company.

M. H. STIMSON, who was recently factory manager of the St. Louis plant of the U. S. Radiator Corporation, has resigned and has become affiliated with Mitts & Merrill of Saginaw, Mich., as assistant general manager.

L. B. JONES, formerly connected with the Bethlehem Fabricators, Inc., has been appointed purchasing agent for the Bethlehem Construction Co., of Bethlehem, Pa.

Obituaries

SAMUEL TWEEDAL, superintendent of the Evansville Tool Works, Evansville, Ind., for 36 years, died suddenly at his home Feb. 26 from heart failure. Mr. Tweedal was born in Philadelphia in 1855 and became interested in the tool business at an early age. In 1893 he was made superintendent of the Evansville Tool Works, where he was actively engaged until his death.

JOHN CAMP WILLIAMS, retired manufacturer and formerly vice-president and general manager of the Western Tool Co., died in New York on Feb. 26 in his 70th year. Early in his career, Mr. Williams lived in Chicago. His retirement followed the sale of the Western Tool Co. to the United States Steel Corporation.

HOMER F. ELWELL, proprietor of the H. F. Elwell Iron Works at Springfield, Mass., died in that city Feb. 23, at the age of 58. He engaged in business in 1890 as manufacturer and erector of structural iron staircases and fire escapes, and continued the business until his death.

JOHN F. BRITT, head of the Britt Machine Works, Eufaula, Ala., one of the oldest machinery enterprises in that section of the Southeast, died the latter part of February at his home in Eufaula at the age of 68 years. Mr. Britt was the organizer of this company several years ago, and was the active head of it since then.

WILLIAM MILLER DUDGEON, president of William Dudgeon, Inc., manufacturer of hydraulic machinery, died on Feb. 28 at the age of 63. He had been inactive for the past six years.

Forthcoming Meetings

AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Regional meeting in Knoxville, Tenn., March 21-22. Eastern spring meeting in Rochester, N. Y., week of May 13. Third national meeting of the aeronautic division, St. Louis, Mo., May 27-30. Semi-annual meeting, Salt Lake City, Utah, July 1-4. Calvin W. Rice, secretary, 29 West 39th St., New York City.

NATIONAL METAL TRADES ASSOCIATION. Convention, Hotel Drake, Chicago, April 24-25. J. E. Nyhan, national secretary, Peoples Gas Building, Chicago, Ill.

AMERICAN WELDING SOCIETY. Annual meeting, April 24-26, at the Engineering Societies Bldg., New York. M. M. Kelly, secretary, 29 West 39th St., New York.

AMERICAN MANAGEMENT ASSOCIATION. Annual meeting, Hotel Pennsylvania, New York, May 7. W. J. Donald, managing director, 20 Vesey St., New York.

AMERICAN GEAR MANUFACTURERS' ASSOCIATION. Thirteenth annual meeting to be held in the Hotel Statler, Cleveland, Ohio, May 16-18. T. W. Owen, secretary, 3608 Euclid Ave., Cleveland.

AMERICAN SOCIETY FOR TESTING MATERIALS. Annual meeting, June 24-28, at the Chalfonte-Haddon Hall, Atlantic City, N. J. C. L. Warwick, secretary, 1315 Spruce St., Philadelphia, Pa.

SOCIETY OF AUTOMOTIVE ENGINEERS. Summer meeting, Saranac Inn, Upper Saranac Lake, N. Y., June 25-28. Coker F. Clarkson, manager, 29 E. 39th St., New York.

NATIONAL METAL EXPOSITION. Eleventh annual, held under the auspices of the American Society for Steel Treating, Cleveland Public Auditorium, Cleveland, Sept. 9-14. W. H. Eisenman, secretary, 7016 Euclid Ave., Cleveland.

MACHINE TOOL BUILDERS EXPOSITION. Under the auspices of the National Machine Tool Builders Association, Sept. 30 to Oct. 4, in the Public Auditorium, Cleveland, Ohio. Ernest F. DuBrul, general manager, 826 Provident Bank Bldg., Cincinnati.

The Weekly Price Guide

Rise and Fall of the Market

SALES and output of iron and steel show gains over a year ago, with prices on the up-trend. Most of the current buying is for railway and automotive material together with structural shapes. Fabricated brass and copper and heavy yellow brass scrap are higher this week at principal market centers. Tin declined ¼c. per lb. and solder ¼c., during the last week. Pig and scrap lead are rising. As a result of higher cost in raw materials, red and white lead advanced ¼c. per lb. above the last change, which occurred in November, 1927.

(All prices as of Mar. 2, 1929)

IRON AND STEEL

PIG IRON—Per gross ton, f.o.b:

CINCINNATI	
No. 2 Southern (silicon 1.75@2.25)	$19.94
Northern Basic	20.89
Southern Ohio No. 2	21.19
NEW YORK—Tidewater Delivery	
Southern No. 2 (silicon 1.75@2.25)	25.50
BIRMINGHAM	
No. 2 Foundry (silicon 1.75@2.25)	16.50
PHILADELPHIA	
Eastern Pa., No. 2x (silicon 2.25@2.75)	21.76
Virginia No. 2	27.17
Basic	20.76
CHICAGO	
No. 2 Foundry local (silicon 1.75@2.25)	20.00
No. 2 Foundry, Southern (silicon 1.75@2.25)	22.26
PITTSBURGH, including freight charge ($1.75) from Valley:	
No. 2 Foundry	19.26
Basic	19.26
Bessemer	21.26

IRON MACHINERY CASTINGS—Cost in cents per lb. of 100 flywheels, 6-in. face x 24-in. dia., hub not cored, good quality gray iron, weight 275 lb:

Detroit	4.50
Cleveland	5.00
Cincinnati	4.50
New York	5.25
Chicago	4.50@4.75

SHEETS—Quotations are in cents per pound in various cities from warehouse; also the mill base in large lots:

Blue Annealed	Pittsburgh Mill Base	Chicago	Cleveland	New York
No. 10	2.10@2.20	3.35	3.25	3.90*
No. 12	2.15@2.25	3.40	3.30	3.95*
No. 14	2.25@2.35	3.45	3.35	4.00*
No. 16	2.35@2.45	3.55	3.45	4.10*
Black				
Nos. 18 to 20	2.80@2.90	3.60	3.40	3.80
No. 22	2.95@3.05	3.75	3.55	3.95
No. 24	3.00@3.10	3.80	3.60	4.00
No. 26	3.10@3.20	3.90	3.70	4.10
No. 28	3.25@3.35	4.50	3.85	4.25
Galvanized				
No. 10	2.80@2.90	3.95	3.75	4.05
Nos. 12 to 14	2.90@3.00	4.05	3.85	4.15
No. 16	3.00@3.10	4.15	3.95	4.25
No. 18	3.15@3.25	4.30	4.10	4.40
No. 20	3.30@3.40	4.45	4.30	4.55
No. 22	3.35@3.45	4.50	4.35	4.60
No. 24	3.60@3.70	4.65	4.45	4.75
No. 16	3.75@3.85	4.90	4.70	5.00
No. 28	4.00@4.10	5.15	4.95	5.25

*Up to 3,999 lb.

WELDED STEEL PIPE—Warehouse discounts are as follows:

	New York		Cleveland		Chicago	
	Black	Galv.	Black	Galv.	Black	Glav.
1 to 3 in., butt welded	50%	36%	55½%	43½%	54%	41%
2½ to 6 in., lap welded	45%	32%	53½%	40½%	51%	38%

WROUGHT-STEEL PIPE LIST

Size, Inches	List Price per Foot	Diameter in Inches—External	Diameter in Inches—Internal	Thickness Inches
1	$0.17	1.315	1.049	.133
1¼	.23	1.66	1.38	.14
1½	.27½	1.9	1.61	.145
2	.37	2.375	2.067	.154
2½	.58½	2.875	2.469	.203
3	.76½	3.5	3.068	.216
3½	.92	4.0	3.548	.226
4	1.09	4.5	4.026	.237
4½	1.27	5.0	4.506	.247
5	1.48	5.563	5.047	.258
6	1.92	6.625	6.065	.28

SEAMLESS STEEL TUBING—Following net prices are for seamless mechanical tubing, cold drawn, round, .10 to .30 carbon, at New York warehouse in lots of less than 100 ft. or 100 lb:

Thickness—Decimal Fractions	B.w.g. and	Outside Diameter in Inches—Price per Foot ⅛	¼	⅜	½	⅝	¾	⅞	1	1⅛	1¼
.035"	20	$0.15	$0.16	$0.17	$0.18	$0.19	$0.21	$0.23			
.049"	18	.17	.18	.19	.20	.21	.23	.25			
.065"	16	.19	.20	.21	.22	.23	.25	.27			
.083"	14	.20	.22	.23	.24	.25	.27	.29			
.095"	13	.21	.23	.25	.26	.27	.29	.31			
.109"	12	.22	.24	.26	.27	.28	.30	.32			
.120" or .125"	11	.23	.25	.27	.28	.29	.31	.33			
.134"	10	.24	.26	.28	.29	.30	.32	.34			

MISCELLANEOUS—Warehouse base prices in cents per lb:

	New York	Cleveland	Chicago
Spring steel, light*	4.50	4.65	4.65
Spring steel, heavier	4.00	4.00	4.00
Coppered Bessemer rods	6.05	6.00	6.20
Hoop steel	4.25†	4.00	4.15
Cold rolled strip steel	6.25	6.00	6.10
Floor plates	5.10†	5.30	5.00
Cold drawn, round or hexagon‡	3.50	3.65	3.60
Cold drawn, flat or square‡	4.00	4.15	4.10
Structural shapes	3.30†	3.00	3.10
Soft steel bars	3.25†	3.00	3.00
Soft steel bar shapes	3.25†	3.00	3.00
Soft steel bands	3.75†	3.65	3.65
Tank plates	3.30†	3.00	3.10
Bar iron (2.75 at mill)	3.24	3.00	3.00
Drill rod (from list)	60%	55%	50%

*Flat, $\frac{3}{16}$-in. thick. †250 to 3,999 lb., ordered and released for shipment at one time. ‡Cold finished steel, shafting and screw stock.

Electric welding wire, New York, $\frac{3}{32}$, 8.35c.; $\frac{1}{8}$, 7.85c.; $\frac{5}{32}$ to $\frac{1}{4}$, 7.35c. per lb.

METALS

Warehouse Prices in Cents Per Pound for Small Lots:

Copper, electrolytic, New York			19.00
Tin, Straits, pigs, New York			52.50
Lead, pigs, E. St. Louis	7.00	New York	8.12½
Zinc, slabs, E. St. Louis	6.35	New York	8.00

	New York	Cleveland	Chicago
Antimony, slabs	13.00	12.50	14.25
Copper sheets, base	27.75	27.75	27.37½
Copper wire, base	23.62½	23.62½	19.87½*
Copper bars, base	26.25	26.25	26.37½
Copper tubing, base	28.87½	28.87½	28.37½
Brass sheets, high, base	22.75	22.75	22.50
Brass tubing, high, base	27.62½	27.62½	27.37½
Brass rods, high, base	20.50	20.50	20.25
Brass wire, high, base	23.25	23.25	23.00

*At mill.

Shop Materials and Supplies

METALS—Continued

	New York	Cleveland	Chicago
Aluminum ingots, 99%	25.00*	24.30	24.30
Zinc sheets (casks)	10.00@10.50	11.70	10.11
Solder (½ and ½)	34.75	34.00	31@34
Babbitt metal, delivered in case lots, New York, cents per lb:			
Genuine, highest grade			69.00
Commercial genuine, intermediate grade			53.00
Anti-friction metal, general service			31.50
No. 4 babbitt (f.o.b.)			12.25

*Delivered.

NICKEL AND MONEL METAL—Price in cents per lb., base, f.o.b. Huntington, W. Va:

	Nickel	Monel Metal
Sheets, full finished	52.00	42.00
Sheets, cold rolled	60.00	50.00
Strip, cold rolled	55.00	45.00
Rods, hot rolled	45.00	35.00
Rods, cold rolled	53.00	40.00†
Tubing	75.00*	90.00
Angles, hot rolled	50.00	40.00
Plates	52.00	42.00

*Seamless. †Cold drawn.

OLD METALS—Dealers' purchasing prices in cents per pound, f.o.b. cars, depending on quantity:

	New York	Cleveland	Chicago
Crucible copper	16.00 @16.25	15.25	14.75 @15.25
Copper, heavy, and wire	15.00 @16.00	14.75	14.12½@14.50
Copper, light, and bottoms	13.50 @14.00	12.50	12.75 @13.25
Heavy lead	5.62½@ 5.87½	6.25	5.00 @ 5.50
Tea lead	4.00 @ 4.50	4.25	4.00 @ 4.50
Brass, heavy, yellow	9.00 @ 9.50	10.00	9.25 @ 9.75
Brass, heavy, red	....	12.75	12.00 @12.50
Brass, light	7.50 @ 8.00	8.25	8.25 @ 8.75
No. 1 yellow rod turnings	10.00 @10.50	10.50	9.75 @10.25
Zinc	3.25 @ 3.75	3.25	3.00 @ 3.50

TIN PLATES—Charcoal—Bright—Per box:

	New York	Cleveland	Chicago
"AAA" Grade:			
IC, 14x20	$12.10	$11.95	$11.50
"A" Grade:			
IC, 14x20	9.70	9.90	9.50
Coke Plates—Primes—Per box:			
100-lb., 14x20	6.45	6.10	7.00
Terne Plates—8-lb. Coating—Small lots—Per box:			
IC, 14x20	7.75@8.00	7.00	7.50

MISCELLANEOUS

	New York	Cleveland	Chicago
Cotton waste, white, per lb.*	$0.10@0.13½	$0.16	$0.15
Cotton waste, colored, per lb.*	.09@ .13	.12	.12
Wiping cloths, washed white, per lb.†	.16	38.00 per M	.16
Sal soda, per lb.	.02	.02	.02
Roll sulphur, per lb.	.027	.03½	.04
Linseed oil, raw, in 1 to 4 bbl. lots, per lb.	.11	.11	.114
Cutting oil, about 25% lard, in 5 gal. cans, per gal.	.55	.60	.65
Machine oil, medium-bodied (55 gal. steel bbl.) per gal.	.30	.36	.35
Belting — Present discounts from list in fair quantities (½ doz. rolls) for leather or rubber:			
Leather—List price, 24c. per lin. ft., per inch of width, for single ply:			
Medium grade	30–10%	30–10%	35%
Med. grade, heavy wgt.	30– 5%	30– 5%	30%
Rubber transmission, 6-in., 6 ply, $1.83 per lin.ft:			
First grade	50%	50–10%	50%
Second grade	60%	60– 5%	50–10%

*All waste in bale lots. †100-lb. bales.

Comparative Warehouse Prices

New York	Unit	Current Price	Four Weeks Ago	One Year Ago
Soft steel bars	per lb.	$0.0325	$0.0325	$0.0324
Cold drawn shafting	per lb.	.035	.034	.034
Brass rods	per lb.	.205	.1925	.165
Solder (½ and ½)	per lb.	.3475	.345	.335
Cotton waste, white	per lb.	.10@.13½	.10@.13½	.10@.13½
Disks, aluminum oxide mineral, cloth, No. 1, 6-in. dia.	per 100.	3.59	3.59	3.10
Lard cutting oil	per gal.	.55	.65	.65
Machine oil	per gal.	.30	.30	.27
Belting, leather, medium	off list.	30–10%	30–10%	35%
Machine bolts, up to 1x30 in., full kegs	off list.	50-10%*	50%*	50%*

*List prices as of April 1, 1927.

MISCELLANEOUS—Continued

	New York	Cleveland	Chicago
Abrasive materials — Standard grade, in sheets 9x11 in., No. 1, per ream of 480 sheets:			
Flint paper	$4.05	$4.29	$4.29
Emery cloth	20.22	20.97	20.97
Disks, aluminum oxide mineral, 6 in. dia., No. 1, per 100:			
Paper	2.04	2.04	2.04
Cloth	3.59	3.59	3.59
Fire clay, per 100 lb. bag	1.00	.75	.75
Coke, prompt furnace, per net ton	Connellsville,		2.75@2.85
Coke, prompt foundry, per net ton	Connellsville,		3.75@4.50
White lead, dry or in oil	100 lb. kegs	New York,	13.50
Red lead, dry	100 lb. kegs	New York,	13.50
Red lead, in oil	100 lb. kegs	New York,	15.00

SHOP SUPPLIES

Discounts from new list dated Apr. 1, 1927, applying on immediate deliveries from warehouse stocks in New York and vicinity:

Machine bolts:	
Up to ¾-in. x 6-in., full kegs, list less	60%
Larger, up to 1 x 30-in., full kegs, list less	50–10%
Less than full kegs or case lots, add to list	10%
Fitting-up bolts: list less	45%
Lag screws:	
Up to ½-in. x 6-in., list less	60%
Larger, list less	50–10%
Less than full keg or case lots, add to list	10%
Rivets:	
Structural, round head, full kegs, net	$4.50
Structural, round head, broken kegs, net	6.00
Tank, 7–16-in. dia. and smaller, list less	60%
Nuts:	
Hot pressed, square or hexagonal, blank or tapped:	
Full kegs up to 1-in., incl., list less	60%
Larger, up to 3-in., list less	40–10%
Less than keg or case lots, add to list	10%
Washers:	
Wrought, full kegs, per 100 lb., list less	$4.00
Wrought, broken kegs, per 100 lb., list less	2.00
Turnbuckles:	
With stub ends, list less	20%
Without stub ends, list less	50%
Chain:	
Proof coil, base per 100 lb., net	$7.10
Cast iron welding flux, per lb., net	.40
Brazing flux, per lb., net	.80

Machine Requirements and Industrial Construction

Equipment Wanted

Mich., Detroit — Gray Hub Co., 3171 Bellevue Ave.—drilling machine.

Mich., Detroit — Hupp Motor Car Co., 3641 East Milwaukee Ave.—presses for metal stamping department for proposed 1 story, 40 x 500 ft. plant. Estimated cost $150,000.

Mich., Detroit — Midwest Tool & Mfg. Co., 2360 West Jefferson Ave.—grinder.

Mich., Detroit—Packard Motor Car Co., East Grand Blvd.—machinery and equipment for the manufacturer of Diesel motors for airplanes for proposed 2 and 3 story, 65 x 125 and 63 x 187 ft. engineering building. Estimated cost $250,000.

Ont., Dundas — Neu Flame Co., A. C. Caldwell, Mgr.—complete new equipment for the manufacture of kerosene stoves, lamps and vacuum pumps for recently acquired factory. Estimated cost $150,000.

Ont., Ford City — Dominion Forge & Stamping Co.—machinery and equipment for metal stamping for proposed 1 story, 100 x 120 ft. addition to factory on Sandwich St. Estimated cost $40,000.

Opportunities for Future Business

Calif., Oakland — Continental Can Co., 155 Montgomery St., San Francisco, awarded contract for a 3 story factory at Russett St. and 54th Ave., here. Estimated cost $600,000.

Calif., West Sacramento—Peerless Iron Works, Second and O Sts., will build a 1 story plant, including 56 x 96 ft. machine shop, 30 x 40 ft. pattern shop and 52 x 64 ft. foundry.

Conn., Hartford—J. H. O'Hara, Kingsley Co., 571 Main St., plans the construction of a garage and repair shop at Wethersfield Ave. Estimated cost to exceed $40,000. Funk & Wilcox, 25 Pemberton Sq., Archts.

Conn., New Haven—South New England Telephone Co., 357 Chapel St., is receiving bids for a 1 story, 125 x 210 ft. garage at Liberty and Putnam Sts. Estimated cost $75,000. D. Orr, 856 Chapel St., Archt.

Conn., New London—Connecticut Motor Bus Transportation Co., c/o F. S. Langdon, 240 State St., Archt., is receiving bids for a 2 story, 80 x 115 ft. garage and service station at Brainerd and Amity Sts. Estimated cost $100,000.

Ill., Chicago — Federal Pipe & Supply Co., 9001 South Campbell Ave.. is having plans prepared for a 2 story factory. Estimated cost $250,000. Graham, Anderson, Probst & White, 80 East Jackson Blvd., Archts.

Ill., Chicago—Vesta Battery Corp., W. S. Perry, Pres., 2100 Indiana Ave., awarded contract for the construction of a factory at West 65th St. and Narragansett Ave.

Ill., Chicago — Western Electric Co., Hathorne Station, will build a 2 story, 50 x 156 ft. factory at 22nd St. and 45th Ave. Estimated cost $77,000.

Ill., Rockford—Wallace Aircraft Corp., 4710 Irving Park Bldg., C. E. Thompson, Pres., Chicago, plans the construction of an 80 x 220 ft. airplane factory here. Estimated cost $100,000.

Ind., Columbus—W. Irwin, 608 5th St., awarded contract for a 2 story, 60 x 100 ft. machine shop and garage. Estimated cost $43,000. Reeves Auto Co., lessee.

Ind., Gary—Illinois Steel Co., is having plans prepared for the construction of a strip mill. Estimated cost $5,000,000. Private plans.

Ind., Marion—U. S. Radio Corp., awarded contract for a 1 story, 72 x 300 ft. assembly plant. Estimated cost $50,000.

Mass., Boston — Eisenberg & Feer, 11 Beacon St., Boston, Archts., are receiving bids for a 1 story, 100 x 120 ft. garage and repair shop at Fenway and Kilmarnock St. Estimated cost $60,000. Owner's name withheld.

Mass., East Boston (Boston P. O.) — Bethlehem Shipbuilding Corp., 100 Milk St., Boston, is having plans prepared for a 1 story, 90 x 225 ft. machine shop at Border St., here. Estimated cost $60,000. H. W. Bisbee, Cole Rd., Hingham, Archt.

Mich., Detroit—Burroughs Adding Machine Co., Cass St. and Burroughs Ave., awarded contract for a 1 story, 60 x 180 ft. adding machine factory at Cass and Burroughs Ave. Estimated cost $50,000.

Miss., Jackson—Walthall Hotel Co., E. O. Spencer, Secy., will soon receive bids for a 4 story auto service building and garage on Pearl St. Estimated cost $75,000. N. W. Overstreet, Mississippi Fire Insurance Bldg., Archt.

N. H., Berlin—Northern Auto Co., Inc., Glen Ave., plans a 1 story addition to repair and service garage. Estimated cost $40,000 to $50,000. Architect not selected.

N. J., Elizabeth — Bd. of Police Commissioners, City Hall, is having plans prepared for a 2 and 3 story, 60 x 150 ft. police headquarters to include machine shop, etc., at Morell and Catherine Sts. Estimated cost $250,000. L. Quien, Jr., 229 Broad St., Archt.

N. J., Irvington — C. Graessle, 113 Prospect Ave., awarded contract for a 2 story addition to factory for the manufacture of lighting equipment at 111-113 Prospect Ave. Estimated cost $40,000.

N. J., Jersey City — Bd. of Education, Harrison Ave., will receive bids about Mar. 1 for a 2 story school including shops, etc. at Van Horne, Maple and Holladay Sts., also plans a 3 story school to include shops, at Boulevard and Fulton Ave. Estimated cost $1,700,000 and $1,150,000 respectively. J. T. Rowland, Jr., 30 Journal Sq., Archt.

N. J., Jersey City—H. Goldwosky, 23 Warner Ave., plans the construction of a 3 story garage at Summit and Sip Aves. Estimated cost $150,000. Architect not selected.

N. J., Kearny (Sta. Arlington)—Western Electric Co., 195 Broadway, New York, N. Y., plans addition to plant, here. Estimated cost $1,000,000 to $3,000,000. Condron & Post, 53 West Jackson Blvd., Chicago, Ill., Archts.

N. J., Passaic—A. Garth, 14 Grove St., will receive bids about Mar. 15, for a 1 story, 140 x 150 ft. garage at 102-108 Gregory Ave. Estimated cost $150,000. F. P. Friedman, 395 Springfield Ave., Newark, Archt. Noted Jan. 31.

N. J., Paterson—Continental Baking Co., Inc., 385 Madison Ave., New York, is receiving bids for a 1 story, 75 x 175 ft. garage on Ellison St. Estimated cost $150,000. Private plans.

N. J., Trenton—J. A. Roeblings Sons Co., South Broad and Canal Sts., awarded contract for a 1 story wire rope factory. Estimated cost $150,000.

N. Y., Brooklyn—Adolph Gobel Inc., 34 Rock St., is receiving bids for addition to garage and repair shop at Thames St. and Morgan Ave. Estimated cost $40,000. Allmendinger & Schlendorf, 852 Monroe St., Archts.

N. Y., Jamaica—Cranford Coal & Land Co., L. D. Kirby, 163-18 Jamaica Ave., is receiving bids for the construction of a garage and repair shop at 23rd Ave. and 182nd Pl. Estimated cost $48,000.

N. Y., New York — Jewelers Building Corp., S. Friedenberg, Pres., 35 West 47th St., plans a 6 story garage at 402 East 61st St. Estimated cost $750,000. Springstein & Goldhammer, 40 East 49th St., Archts. Maturity July or August. Noted Feb. 7.

N. Y., New York—Private Garage Apartments Inc., A. J. Post, Pres., 101 Park Ave., awarded contract for an 8 story, 102 x 175 ft. garage at 420 East 76th St. Estimated cost $300,000.

N. Y., New York—P. Butrico, 2754 Creston Ave., plans a 2 story, 71 x 140 ft. garage at University Ave. and 168th St. Estimated cost $75,000. P. Cancellier, 2422 Cambrelling Ave., Archt.

N. Y., New York—K. Flanigan, 10 West Fordham Rd., plans the construction of a 1 story, 100 x 169 ft. garage at Tibbett Ave. and 231st St. Estimated cost $40,000. M. Singer, 766 East 161st St. Archt.

N. Y., Tonawanda — New York Central R.R., 466 Lexington Ave., New York, plans the construction of new switch yards, etc., here. Estimated cost $500,000. F. B. Freeman, New York, Ch. Engr.

N. C., North Wilkesboro — Home Chair Co. plans the construction of a 90 x 105 ft. factory.

O., Cincinnati — Cincinnati Milling Machine Co., Marburg Ave., awarded contract for a 1 story factory. Estimated cost $80,000.

O., Cleveland—Bd. of Education, F. G. Hogen, Dir., awarded contract for a 1 story foundry on Eagle Ave. Estimated cost $44,000.

O., Cleveland — Carnegie Body & Top Co., E. S. Eckstein, 6115 Carnegie Ave., is receiving bids for a 1 story, 97 x 155 ft. addition to shop, etc. Estimated cost $50,000. J. F. Steffens, Fidelity Bldg., Archt. Noted Feb. 28.

O., Cleveland — Cleveland, Cincinnati, Chicago & St. Louis Ry. Co., 230 East 9th St., Cincinnati, is receiving bids for a 1 and 2 story addition to round house, service building, etc., at Lenndale yards, here. Estimated cost $450,000. H. Baldwin, Ch. Engr. Noted Feb. 14.

O., Elyria—Fox Furnace Co., 206 Washington Ave., had plans prepared for a 1 story, 101 x 119 ft. addition to foundry and factory. Estimated cost $50,000. G. S. Rider Co., Century Bldg., Archt. and Engr.

Pa., Latrobe—Latrobe Electric Steel Co. awarded contract for a 1 story addition to plant. Estimated cost $40,000.

Pa., Philadelphia—General Electric Co., 7th and Willows Sts., awarded contract for a 1 story, 80 x 180 ft. and 50 x 75 ft. factory and service building.

Pa., Philadelphia—J. J. Nesbitt, State Rd. and Rhawn Sts., awarded contract for a 1 story, 108 x 142 ft. addition to factory for the manufacture of ventilators. Noted Feb. 21.

Pa., Pittsburgh—Electropure Sales Corp., 605 E. E. Trust Bldg., is having plans prepared for a 2 story, 35 x 50 ft. factory at Liberty Ave. and 13th St. Estimated cost $40,000. Braziell & Anderson, 309 4th Ave., Archts.

Pa., Pittsburgh — Pittsburgh Gray Iron Foundry Co., South Shore and Walker Sts., will receive bids about Mar. 7 for a 1 story, 32 x 154 ft. addition to foundry. Estimated cost $80,000. Hunting, Davis & Dunnells, Century Bldg., Archts.

Pa., Warren—Thomas Flexible Coupling Co. is receiving bids for a 1 story, 60 x 200, 40 x 100 and 40 x 60 ft. plant. Estimated cost $100,000. Private plans.

R. I., Providence—Petteruti's Motor Sales Co., 1051 Chalkstone Ave., awarded contract for a 1 story, 60 x 100 ft. garage and repair shop. Estimated cost $40,000. Noted Oct. 11.

Tex., Coleman — A. G. Beach and E. J. Powell, awarded contract for a 1 story, 70 x 103 ft. garage. Estimated cost $32,000.

Ont., Hamilton—Cadillac Motor Sales Co., 776 King St. E., is having plans prepared for the construction of a 2 and 3 story garage, etc. Estimated cost $200,000. Hutton & Sauter, 6 James St. S., Archts.

Ont., Toronto — Miller Lithographic Co., 100 King St. W., awarded contract for a 2 story, 149 x 149 ft. plant on Adelaide St. W. Estimated cost $100,000.